The American CINEMATOGRAPHER

VOL. 3, NO. 2 LOS ANGELES, CAL. MAY, 1922 TWENTY-FIVE CENTS A COPY

"Loyalty to Progress in Art"

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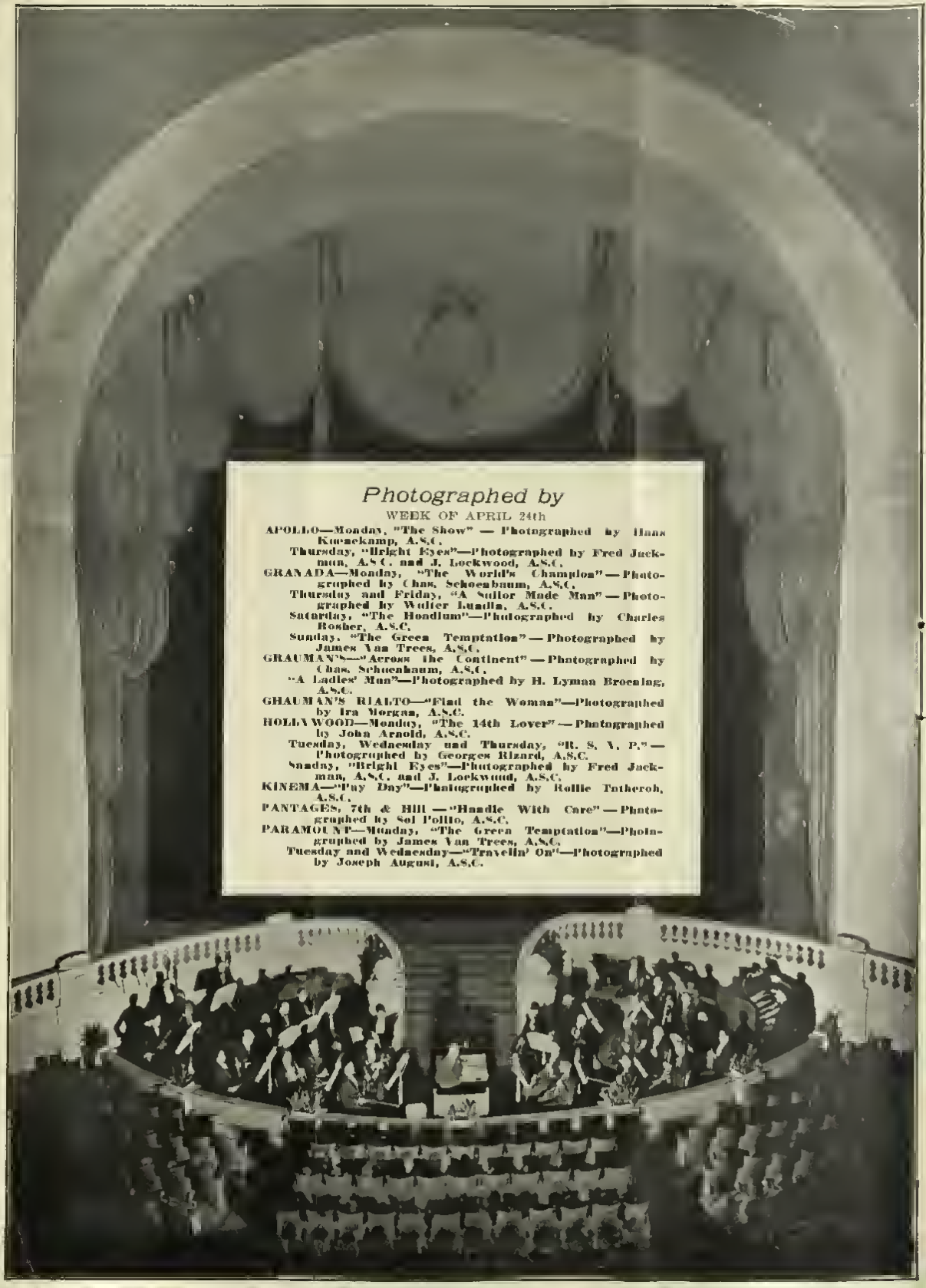
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WEEK OF APRIL 24th

APOLLO—Monday, "The Show" — Photographed by Hans Kuneknamp, A.S.C.
Thursday, "Bright Eyes"—Photographed by Fred Jackman, A.S.C. and J. Lockwood, A.S.C.
GRANADA—Monday, "The World's Champion" — Photographed by Chas. Schoenbaum, A.S.C.
Thursday and Friday, "A Sailor Made Man" — Photographed by Walter Lundin, A.S.C.
Saturday, "The Headlum"—Photographed by Charles Rosher, A.S.C.
Sunday, "The Green Temptation" — Photographed by James Van Trees, A.S.C.
GRAUMAN'S—"Across the Continent" — Photographed by Chas. Schuenbaum, A.S.C.
"A Ladies' Man"—Photographed by H. Lyman Broening, A.S.C.
GRAUMAN'S RIALTO—"Find the Woman"—Photographed by Ira Morgan, A.S.C.
HOLLYWOOD—Monday, "The 14th Lover" — Photographed by John Arnold, A.S.C.
Tuesday, Wednesday and Thursday, "R. S. V. P." — Photographed by Georges Rizard, A.S.C.
Sunday, "Bright Eyes"—Photographed by Fred Jackman, A.S.C. and J. Lockwood, A.S.C.
KINEMA—"Pay Day"—Photographed by Rollie Totheroh, A.S.C.
PANTAGES, 7th & Hill — "Handle With Care" — Photographed by Sol Polito, A.S.C.
PARAMOUNT—Monday, "The Green Temptation"—Photographed by James Van Trees, A.S.C.
Tuesday and Wednesday—"Travelin' On"—Photographed by Joseph August, A.S.C.

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VOL. 3 HOLLYWOOD, CALIFORNIA MAY 1, 1922 No. 2

The American Cinematographer

The Voice of the Motion Picture Cameraman of America; the men who make the pictures.

Board of Editors—J.A. DUBRAY, H. LYMAN BROENING, KARL BROWN, PHILIP H. WHITMAN
SILAS E. SNYDER, Editor

COMING IN JUNE

The June number of The American Cinematographer will be superior in quality of subject matter to any yet issued.

Joseph Dubray, A.S.C. will have an article on co-operative production of motion pictures. He can tell his story because he has "co-operated."

Karl Brown, A.S.C., will contribute Section Two of his big comprehensive article on "Modern Lenses." This article when complete will constitute a text book on lenses. Don't miss any of it.

William Lee Woolett was delayed in finishing his article on art promised for the May issue, but it will be completed in time for the June Cinematographer. Mr. Woollett is one of the foremost artists and art critics of his time and he will tell how the motion pictures are conserving art.

Herford Tynes Cowling, A.S.C., promises one of his interesting travel articles and if his Corona arm doesn't give out he will tell about filming the King of Siam at the Shrine of the Emerald Buddha.

Alfred B. Hitchins, director of the Research Laboratory of the Ansco Company, will offer one of his famous technical studies, and there will be much more.

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MODERN LENSES. *All About the Manufacture and Use of the Leading Lenses of the World.*
By **Karl Brown, A.S.C.**

FILMING A FISH FIGHT.
The Strangest Sight Ever Filmed.
By **Herford Tines Cowling, A.S.C.**

THE EINSTEIN THEORY IN FILMS
Produced in Germany.

COLD LIGHT. *Some Suggestions and a Note on a New Discovery.*
By **Dr. Gilbert Ellis Bailey.**

THE BEGINNING OF THE CINEMA.
Birth of the Final Form—From "The Story of the Motion Picture."
By **Ben J. Lubschez.**

THE CINEMA COLLEGE.
A Film Normal School for Teachers.
By **John Leezer, A.S.C.**

TEN THOUSAND PICTURES PER MINUTE
By **C. Francis Jenkins, S.M.P.E.**

ANALYSIS OF MOTION
By **C. P. Watson, S.M.P.E.**

MOTION PICTURE NOMENCLATURE
S.M.P.E.

JIMMY, THE ASSISTANT
Talks About the Neighborhood Theatre.

A STANDARD DENSITY IN THE PRINTING OF MOTION PICTURE FILMS
A Technical Treatise.
By **J. E. KROESEN, S.M.P.E.**

THE A. S. C. ELECTS OFFICERS

HOW THEY GET THE SNOW STUFF!
Pictures by **"Bill" Nye.**

WHAT IS A GOOD NEGATIVE?
By **Abe Scholtz, A.S.C.**

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EDITORIAL

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We cordially invite news articles along instructive and constructive lines of motion picture photography from our members and others active in the motion picture industry. All articles must be signed by name of writer.

Meetings of the American Society of Cinematographers are held every Monday evening in their rooms, suite 325 Markham Building. On the first and third Monday of each month the open meeting is held, and on the second and fourth the meeting of the Board of Governors.

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Modern Lenses

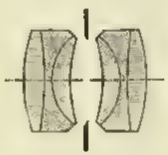
FIRST SECTION

By Karl Brown, A. S. C.

(NOTE: The object of this article is, primarily, to give the result of careful investigation of the structure, image quality, and best application of the different lenses offered for sale which are valuable for motion picture purposes. For the benefit of those beginning the study of cinematography, as well as interested non-professionals, it is thought advisable to prelude the rather technical review of the various lenses with an explanation of the general principles of lenses and their manufacture.

When this article was first planned, a request was made to a number of prominent lens makers to contribute such material of historical and technical nature as might add to the educational value of the treatise. The response has been extraordinary. The author finds himself in possession of so much valuable and hitherto unpublished information concerning lenses, written by men in position to be authorities, that he can do no better than simply act in an editorial capacity. For the major portion of the first part of this article, THE AMERICAN CINEMATOGRAPHER is deeply indebted to Mr. Harold M. Bennett, whose contribution gives an exceptionally clear exposition of the process of lens manufacture.

The Genesis of a Photographic Lens



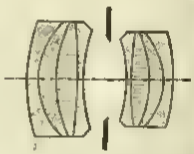
Double Amatar F/6.8

Less than a century ago photography butted crudely enough into the sanctuary of legitimate art, and like many another budding invention, was condemned in the cradle as a wicked chimera. In our days photography has grown into one of the most highly developed auxiliaries of experimental and applied science, including the study of that part of the cosmos which is beyond human sight, no less than an inexhaustible servant of industry and commerce; to say nothing of photography as an independent art and a source of pleasure and sentiment.

The history of the development of the photographic lens furnishes the key to all other progress in photography, for every advance in the chemistry and practice of photography has had its pace set by the optical capacity of the photographic lens, and so it has come about that a height of development has been attained which far transcends the wildest imagination of the past. Yet how many people are there who have an adequate conception of the infinite amount of genius and toil which lies recorded in the life history of a modern photographic lens. Such a lens is indeed such a wonderful epitome of mental effort and mechanical skill that it may be worth our while to retrace its path from the computer's mind to the photographic camera.

The photographic objectives, as now used for practical purposes, consist of a more or less extensive number of component lenses. It may be asked why this should be so, since it is well known that an ordinary reading glass is capable of producing upon the ground glass screen of the camera an image of external objects. This is true enough, but so soon as we proceed to examine such an image more closely, we shall see that it is hopelessly defective. Its general sharpness leaves much to be desired, and such as it is, it rapidly declines from the middle to the edge of the image. These defects may not be so very striking when the image is viewed as a camera obscura picture, but they stand out in all their glaring intensity when recorded upon the photographic plate. Photography here introduces requirements which at once places the photographic lens in the category of difficult problems, and indeed it has taken generations to solve them step by step. A single lens cannot fulfill these requirements to any degree, and it needs therefore a combination of several lenses to overcome the many defects which arise. Modern photographic lenses are accordingly composed of a considerable number of lenses. In most cases they comprise 4, 6, indeed 8, and even 10 lenses associated to form an objective. From this it must not be thought that the mere number of component lenses of which an objective is made up is a criterion of its quality.

Note the construction of the **Zeiss Double Amatar.** The combination consists of six lenses arranged in sets of three cemented together with Canada balsam. Each of the three front lenses, or of the three back lenses, is made of a distinct kind of glass. Why this is so you will see later. **The Zeiss Tessar** construction is comparatively simple, for it consists only of four thin lenses, two of which are cemented together, whilst the other pair is separated by a stratum of air, forming the 'air lens' as it were. Whilst the objective is simple enough as far as the mere number of lenses is concerned its actual manufacture demands an extreme degree of precision: the distance between the lenses, for example requires to be exact within 1-100 millimetre or the 1-2500th part of an inch.



Double Protar F/7
also F/6.3 or F/7.7

Let us now see what are the essential defects of a simple lens which stand in the way of the formation of sharply defined images and which force the optician to employ such complicated means.

We cannot possibly attempt to enter into the theory of the photographic lens, but we shall do well to briefly consider the general aspect of lens defects.

The rays which fall upon a converging lens, such as an ordinary reading glass, near the rim of the lens are refracted towards the axis in a more pronounced degree than those which are incident at the middle. In consequence rays which proceed from a point are not made to meet exactly at another point, and hence the resulting image of the point is far from sharp. The defect which arises from this source is called **spherical aberration.**

White daylight, as well as the light of artificial sources, consists of rays of different colors and qualities, which in the aggregate constitute what we know as white light. These rays of different qualities are refracted by a lens in different degrees, which occasions a further species of image defects. These defects are comprised under the term **"chromatic aberration."** They are far more pronounced in the case of oblique and skew rays than in that of rays that are parallel to the axis, so that the sharpness of the image deteriorates very rapidly from the centre to the edge. Since both these defects are turned to advantage in the making of soft focus lenses, they will be more fully explained under that heading.

A simple lens, moreover, fails to reproduce straight lines near the edge of the image as **straight lines.** On the contrary it gives rise to distortions which vary fra-

quently entirely vitiate the pictnre. The natura end intensity of these distortions depend upon the form of the lens end the position of the stop

Again, the lmage formed by a simple lens does not lie in one plane, hut on a spherical surfece, and hence it is impossible to obtaln an image which is sharp at the centre, and, **without re-focussing**, also at the edges Another exceedlngly disturblng defect arises from **astigmatism**, which likewise occaslons a rapid deterloration of the sharpness of the lmage towards the edges

All these defects, wlth the exception of distortion, con be lessened or removed by the use of small stops,—thet is true enough But this greatly diminishes the light-transmittlng power of the lens so thet it becomes much too slow for teking instantaneous photographs Modern photography demands, therefore, objectives in which all these defects are corrected from the outset, so thet they will give sharp and undistorted pictures over the entire plete when workIng at full aperture. The spherical and chromatic aberrations can be removed by cementing together two lenses of appropriete curvatures and made from glasses with different optical properties, so that their defects may be simllar but opposite ln kind, end so neutralizing the errors By this means we obtein a lend-scape lens Two landscape lenses of this kind facing each other end having a stop in the middle between them form an **aplanatic or Rapid Rectilinear** lens, in which the correctlon of spherical and chromatic defects goes hend in hand with the elimination of the coma, a form of spherical aberration and distortion. In order thet the very objectionehle defects, due to astlgmatism, may be removed, it ls necessary to add further lenses or to construct the objective on a different plan altogether

For e long time it was thought to be impossible to remove the two lest named defects, or et least to remove them hoth at the same time. since no glasses were then in existence by which theoretlcal echievements could be translated into fact When new glasses were discovered it became possible to make great advences in the improvement of photographic lenses, and so lenses came into being ln which these two last named defects were entirely ebsent, or at least reduced to a practlcelly inappreciable amount.

We have observed thet the various lens systems are made up of four to elght components which are partly detached and partly cemented lenses Each of the two or three front or hack lenses of a combination consists of distinct kinds of glass which are the outcome of very exact trials The cementing medium ls Conade holsam.

As we heve already seen, the glass of which the lenses are made is not en arbitrary matter On the contrary, this glass must heve very definite qualities Foremost among these qualities ere the **refractive index and the color dispersion.** A pencil of light passing through a prism ls deflected from its original course. The degree of the deflection depends upon the refractive power of the glass of which the prism is made The refracted pencil spreeds out as it passes through the prism, so that when it reaches a white screen it does not form an exact lmage of the narrow slit from which it proceeded, but will be seen to have heen drawn out into e colored band The prism does not refract **uniformly** all the colored rays of which the white light is made up It dsflects the violet and hlue reys to a greater extent then the green rays and these again to e greater extent then the yellow and red reys In consequence, the colored reys of the illuminated slit do not meet in one place, where their mixture would have furnished white light hut ara ranged side by side, thereby forming the **spectrum**, of which we have a familiar exampla in the rainbow The color dispersion varies widely for different kinds of glass Many glasses produce long hands, others yield much shorter hands, ln soma the blue end is more distended, in others this happens at the red end. We thus see why almple lenses, which ara simply curved prisms, are bound to have the defect of chromatic aberration.

Formerly it was believed the color dispersion and refractive power were mutually dependent. They are so, as a matter of fact, more or less, but not to anything like the extent es was supposed, at a time when crown and flint glasses only were known. The crown glasses heve a comparatively low refractive power and at the same time are only able to form a short spectrum band, whereas ln the case of the flint glasses a high refractive power is associated with a considerable emount of dispersion. The manufacture of modern optical glasses, however, has rendered largely fictitious the old distinction hetween crown and flint glasses, in thet now there are glaeses which have a comparatively low refractive power and nevertheless furnish spectrum hands of greet length and conversely. With two kinds of glass, that is to say, an old crown glass and flint glass, it is not possible to unite more than two colors, say yellow and blue, at a single point The remaining rays continue to give rise to a more or less noticeable hlurred fringe, which is known as the "secondary spectrum" Photographic lenses with a secondary spectrum are nevertheless well edapted for the ordinary purposes of photography, and it is not till we come to face the problems of three-color photography that it becomes necessary to bring to a common focus other colors of the spectrum, e g. red Objectives of this order of correction are called **"apochromatic lenses."** They are now used almost exclusively in photographic process work.

The two classes of the old crown and flint glasses were for a long time the only means which were available for the construction of lenses. Fraunhofer, at the beginning of the last century, realized that these two kinds did not suffice for the realization of his newly computed telescope objectives. It is not saying too much that Fraunhofer inaugurated by his achievements the era of modern applied optics It was he who first associated systematic knowledge and a scientific system with the art of lens making, which until then had heen a mere matter of handicraft He was also first to describe exact methods for making strictly spherical surfaces.

Wonderful as were the achievements of Fraunhofer, there still remained a tremendous stride to be taken hefore the technical methods now in use could be developed The uncertain element of personal skill has now heen superseded in a large degree by a highly organized system of mass production with the assistance of every available developed and minutely elaborated scientific and mechanical refinement This is apparent in the construction of a combination of lenses. In the old days the optician guided by experience and a more or less trustworthy intuition, would grind lenses by way of a trial, combine them, and then proceed to vary the curvatures of the lenses and their combinations until the desired result wee attained in a more or less complete manner.

This procedure by trial and error was a tedious and uncertain business Fraunhofer was the first to replace it, at least to a considerable extent, hy a system of **predetermination.** This method was further developed hy Steinheil It was, however, left to **Prof. Abbe,** the then Director of the University Observatory at Jena and snbsequently head of the Carl Zeiss Works, to evolve a complete system of predetermination of **all** the data for the construction of microscopic objectives made hy Carl Zeiss Despite all these achievements there would have been little tangible advance in applied scientific optics, if a went of suitable glasses had been allowed to persistently stand in the way of the improvement of optical instruments. It was Abbe who time and egain brought into view the enormous improvements which might be effected if only the requisite glass were at the disposal of the producers of lenses. Inspired hy his reiterated utterances, Dr. Otto Shott, who had graduated in the school of the Westphalian glass industry, conceived the idea of varying the optical properties of glass hy introducing new materials into their formulas He became associated with Prof Abbe, who had at once realized the full significance of these experiments It is to their systematic combined working that we owe the unexampled development of modern practical optics As Abbe had done in the making of lenses, so Schott proceeded along strictly scientific lines in his experimental glass emelting op-

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srations, in that he systematically investigated the correlations between the optical constants of the glasses and their composition and the effect of the introduction of new constituents. He succeeded in the course of his experiments in producing glasses the properties of which had formerly been a pious dream-wish of investigators but the fulfillment of which had never been looked for as a realizable thing.

Before we proceed to consider the making of lenses we shall do well to review the process by which the optical lenses are made, and we shall do so in the form of an imaginary tour of inspection through a modern optical glass works, such as the Jena glass works.

While passing the enormous stores of raw materials which the establishment works upon, the uninitiated may find it difficult to realize how the opaque substances which he there sees heaped up, come to furnish the beautifully clear and transparent material which he afterwards sees as glass. Chemically considered, glass is a solid solution of silica and silicates, which are obtained by fusing together quartz sand, soda and lime.

These substances were in the main the raw materials from which the old glasses were made. The materials from which the new optical glasses are made include in addition borates, phosphates, barium compounds, lead compounds, and fluorites, hence metals, such as sodium, barium, and lead, are likewise among the constituents of these water-clear glasses. Some kinds of flint glass contain even as much as seventy per cent of their weight of lead and are nevertheless perfectly transparent.

Every kind of glass is obtained by melting a mixture of these compounds, and naturally every glass has its own particular formula.

The technical effect of the fusion of the optical glass is as interesting as its production is difficult. The trouble begins with the preparation of the melting pots, which are made of alumina. The material of which they are made should part with little or nothing to the mass of the melting glass. On the other hand, they must be able to resist the enormous heat of the boiling mass. The pots are accordingly made on the spot. The pots, some five feet in diameter, are stored in a gigantic shed accommodating on the aggregate one thousand pots. Storage of such large numbers is necessary as the pots require to stand for many months, to dry out quite slowly before they may be fired. Before use they are warmed up in special ovens, after which they are charged with the mixture. Every pot holds about two tons of glass material. In the event of the pots having a flaw, such as an externally invisible crack which has formed during the process of drying, it may happen that they burst during the process of melting, with the result that their valuable contents are lost.

The component materials for the various meltings are stored in large silos. They are mixed mechanically. The mixture is heaped up in the pot and melted down by gaseous fuel at a temperature of about 1500° C. (2750° Fahrenheit.) During the process of melting the raw materials act upon one another and gases form which rise in bubbles within the more or less viscous mass. This is also the reason why it is not possible to obtain optical glass which is entirely free from bubbles. For a long time the success attending these melting operations was very incomplete, and only a small portion of the ingot had the desired properties owing to imperfect mixing. This evil can be overcome to a certain extent by stirring. The idea of stirring the incandescent liquid mass was simple enough, but it is nevertheless an ingenious and most important artifice, which was originated by a Swiss joiner named Guinand, who was the first to melt glass for optical purposes. The stirring is done with the aid of a bar of alumina, which is suspended from a gear within the melting furnace so as to dip vertically into the molten mass, and is moved therein in a circle, until all differences in the constitution of the various parts dis-

appear by mixing. Tha melting process requirss about 18 hours hafore it is complete From time to tima an experienced oparator withdraws a sample from the ingot hy means of an iron rod This test sample snppplies a criterion as to whether the homogeneous fusion of the ingot is complete As soon as this is found to he satisfactory tne melting pot with its contents of about two tons of incandescent liquid mass is drawn from the fire by means of large tongs moving on trolleys The pot, which is white-hot, is transferred to another furnaca, where it is allowed to cool down slowly within a week. During this period of cooling the glass contracts and in so doing breaks up into irregular large and small pieces resembling ice hlocks in appearanca In many cases tha pot breaks up as well in consequence of tha strains set up by this contraction

The resulting pieces of glass are then sorted, and cracked pieces ara completely severed with a hand hammer, so that any cracks which may already be present may not continue and result in defects when the material comes to be worked up latar on From the resulting broken up pieces the good ones only are selected for the purpose of reducing them to the regular form of plates which the optician receives for making his lenses and prisms

The rough pieces picked out in this way are then remoulded in a separate re-heating furnace in rectangular moulds of fireclay until the glass becomes viscous, so as to fill the mould When in this way the glass has assumed the shape of the mould it is subjected to the **fine annealing process**, a very slow cooling which usually requires one month. but in the cases of large pieces may he extended over a period of 2 to 3 months This slow cooling is necessary to free tha glass from **internal strains**: for, though the stirring has tha affect of producing a chemically homogeneous glass, stresses ara liahle to be sat up during the process of cooling, which renders it quite useless for optical purposes. Now, any piece of glass in a state of intense compression acquires the properties of crystalline hodies and is double refracting, that is to say, it splits up a single incident ray into two rays. It goes without saying that this is a property which cannot for a moment ha tolerated in a photographic lens. Before the glass is passed on to the optician it is therefore carefully tested with respect to internal strains as well as the presence of Istriae, or veins This, however, cannot he done without further preparation for the glass piates as furnished hy the re-moulding process are not transparant hut have a rough and uneven surfaca The plate is therefora roughly ground and polished on two opposite sides, so that the glass may be tested hy transmitted light with respect to tha prasence of hubbies and striaa.

Experienced workmen, looking through the polished edges of the plate towards a suitahle source of light, such as a mercury vapor lamp, at once recognize these portions of the glass which differ from the adjoining portions by a difference in the light-refracting properties. If we let a drop of sugar solution fall into a tumhlerful of water, the sugar soiution, being heavier than water, will sink to the hottom, and in doing so it will leave a visihle trail which is due to the dilute sugar solution having a refractive index differing from that of pure water. The striae in glass present a very similar appearance. Closely packad fine striae are dangerous enemies, and any piece of glass containing these is at once rejected Frequently flaws arise which in their appearance resemble a fine ice texture stretched across the mass of glass These cloudy layers arisa from tha re-fusion during the re-moulding process of a crack in the glass which has escaped observation in the previous tests. The examination for internal strains which, as we have seen, occasions double refraction within the glass, is made by polarised light.

Slabs ohtained from the ingot are placed side hy side over a larga hlack glass mirror set at an appropriate angle and examined through a Nicol prism which travels along a rail. There is a source of light in front of which is placed a Nicol prism, the so-called polariser, from which polarised light proceeds to the right towards the

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observer. This polarized light passes through the glass block in the middle and the latter is carefully examined from piece to piace hy means of a telescope focussed upon it. This telescope has mounted in front of it another Nicol prism, the so-called analyser. When the polariser and analyser are in such a position relatively to each other that the planes of polarization are at right angles to each other, no light will reach the eye of the observer unless refracted out of direct line hy the glass being tested. If the glass is normal, no refraction will take piace, hut if there are any strains in the glass they will give rise to a rotation of the pianes of polarization, and ehow as beautifully colored irregular patches.

In the end it is found after the application of these preliminary tests that ahout 85 per cent of the whole mass of glass is to he rejected as useless, so that a hundred-weight of glass produced often furnishes only 15 pounds of glass which is adapted for optical purposes. The rejected glass cannot he redeemed by re-melting but has to be sold as waste product to other glass-houses where glass is used for the manufacture of ordinary glassware. For any attempt of re-melting would only have the effect of producing glass in which the flaws to he avoided would he present in a highly accentuated degree.

When glass is required for making lenses over 12 inches in diameter it follows from all this that the pieces ohtained from a broken-up pot of glass cannot be used, and it hecomes necessary in this case to pour the liquid mass into a large iron mould and allow it to cool therein quite slowly. As hefore, the surface of this moulded piece is polished at two places on hoth sides. The usahle portions are picked out and trimmed and then re-moulded in the usual way. The glass is now ready for disposal to the manufacturing optician.

By the latter it still requires to be tested with respect to its optical constants, for different batches are not identical in their optical properties. Despite the exercise of the utmost care in weighing off the constituents there are always small variations. The manufacturing optician cuts therefore from the plates supplied to him small pieces, which he proceeds to grind and polish in the form of prisms to enahle him to ascertain the optical constants. The deviations from the standard values are in the majority of casee very slight, yet too great to be ignored. The calculated data of the optical instrument for which the glass is required need therefore some sight rectification hy small alterations in the radii, the thicknesses of the lenses, their distances apart, etc., so as to bring them into line with the slight variations in the constants, assuming, of course, that the calculator has completed the fundamentally important work of the computation of the entire system of lenses.

The mathematical methods of optical computation cannot he gone into here. It must suffice to say that all the requisite data have to he laboriously calculated in succession with the aid of trigonometrical formulae. When a successful combination has been arrived at which satisfies all given requirements an exact drawing with a description of the radii, thicknesses, diameters of lenses and the kinds of glass to be used is handed into the workshops.

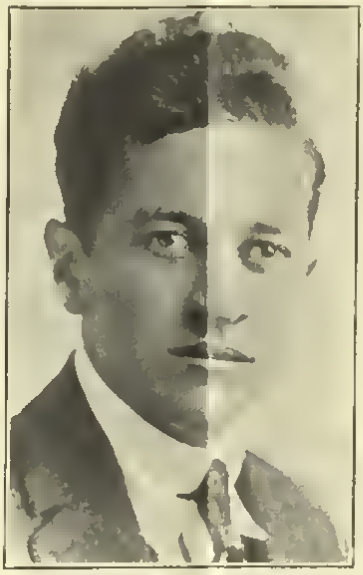
The first step there is to make the grinding tools which are required to shape the lenses. These are in the form of flat cups of cast iron or hrass having the reverse curvature to that which the finished lens is required to have. To make a converging lens with a convex surface a concave tool is accordingly required, whereas a mushroom-headed tool will be needed for making a concave lens. The surfaces of these tools are turned on the lathe with the utmost precision with the assistance of fine measuring instruments. Before proceeding to grind the lenses the unworked glass plates require to he reduced to a form which will save a maximum of material and labor. The plates are accordingly sawn into pieces which are hut little thicker than the thickest portion of the required lens. This sawing operation was formerly performed with a kind of fiddle-bow saw, the hlade of which was replaced hy a steel wire. By means of this, together with emery and water, the glass was sawed into pieces. Today this is done invariably with the aid of a rotating iron disc, the rim of which is charged with fine diamond splinters. The wheel is set in very rapid rotation by a motor and cuts up the glass in a very short time. The approximate contour of the required lens is now drawn with a pencil upon the slah of glass, and all superfluous material nihhled off hy means of pliers with soft iron jaws. The piece is then given an approximately circular form on a grinding stone with the assistance of sand and water. When the piece has been prepared in this way in the rough the operation of lens grinding proper hegins.

The grinding tools which have already been described are moved to and fro, whilst the piece of glass which is to be ground is cemented to a rapidly rotating spindle, whereby it is pressed against the tool. It is usual to grind several lenses together by cementing a considerable number of them to a large tool of the reverse curvature and working them jointly.

The ahrading material used is emery together with water. Course emery is employed first for ohtaining the required form. By the gradual introduction of finer grades of emery the rough portions of the surface are smoothed down, until finally it presents a finely-greyed appearance. The workmen control the grinding process and see to it that there is always sufficient abrading material and water hetwesn the work piece and tool. During the process of grinding, the surfaces are constantly tested hy delicate measuring instruments. Every surface of each single lens is examined repeatedly in this way. Since the tools themselves are suject to abrasion during the process they themselves require to he continuously tested as well.

Apart from the prescribed curvatures of the surfaces of the lensas, their thickness requires to conform rigorously to the calculated amount, as this constitutes likewise an important element in the required optical scheme. In fact the thicknesses of the lenses must likewise he realized within the 1/2500th part of an inch. A

Gilbert Warrenton, an Officer



Gilbert Warrenton, one of the youngest members of the A. S. C. was chosen third-vice-president at the annual meeting, April 11th, 1922, and he will handle the gavel when the president and the first and second-vice are absent on location or working nights, as the poor cinematographer often has to do.

Mr. Warrenton, though young in years, has won an enviable standing in his profession and is popular among the members of the Society. He is a son of Mrs. Lule Warrenton, famous as a director of motion pictures for children and one of the pioneers of West Coast cinema activities.

special instrument is used for measuring the thicknesses of lenses The lens which is to be tested is placed upon a plate and the freely movable contact pin made to rest upon it. By means of a reading telescope the thicknesses may be read off with the utmost precision upon a fine scale.

When the lenses have acquired the desired form on two sides, the next step is to polish them. This is done in a similar manner as the grinding, the grinding tool being replaced by the polishing tool and the emery by jeweller's rouge. The polishing tool is simply an impression of the so-called standard-proof lens in pitch and is obtained after the manner of a sealing wax impression by lining the grinding tool with pitch and pressing into this, while still soft, the counter-mould. The lens is then operated upon with rouge and water until it has taken on a firm polish

Polishing in the pitch tool with rouge gives the best possible results, since in this way the spherical form comes out best A dry method is preferred in those cases only where the polished surfaces serve as an intermediate stage in manufacture. To apply this method cloth or paper is fixed by an adhesive to the tool and rouge rubbed into the latter.

The lens is now subjected to a final and exceedingly severe test. For this purpose it is not sufficient to apply mechanical means, and hence it becomes necessary to adopt an optical method The test is made with the aid of the standard proof lens. Everyone is familiar with the colors of soap bubbles, and many will have noticed the rainbow colors which a thin film of oil produces when floating on water, and some may have observed that when a spectacle glass as worn by a long-sighted person is placed upon a glass plate a series of narrow rings in close succession are visible at the point of contact A similar appearance occurs when two glass plates are pressed together Here, too, colored rings are formed. The phenomenon is due to the formation, by reflection of light at the free surfaces of thin films, of interference colors, which are governed by the thickness of the film. The walls of the soap bubble, the thin layer of oil and the thin stratum of air between two glass plates pressed together constitute thin films of this kind When they are of uniform thickness at all points they exhibit one color only which depends upon the thickness of the film.

Taking advantage of this principle, optical workshops provide themselves with extremely accurately made standard proof glasses for all curvatures with which they are concerned in their lens making operations A standard-proof glass of this kind has the reverse curvature to that of the lens which is to be tested, and to test the latter it is pressed upon the proof lens Any faulty part will at once be made manifest by the appearance of colored rings, since at such a point there will be air strata of different thicknesses. If the lens which is to be tested has an exact curvature without a fault the entire surface of the proof lens will appear colorless, or if the deviations of the surfaces amount only to fractions of one wave-length they will exhibit a single color. The method is so exceedingly sensitive that slight warming of a portion of the lens by the warmth of the hand suffices to give rise to irregular colors. It goes without saying that the radii of curvature of the proof glass must be measured in millimetres in the most exact manner, if they are to serve as the basis of lens surfaces to be tested with their aid.

The apparatus designed for measuring these radii of curvature is of extreme delicacy. The proof glass lies with the surface which is to be measured facing downwards on a tapering metal ring of an exactly measured diameter, and a freely movable pin is pressed from below against the surface of the proof lens. The amount of the so-called versed sine of the proof glass surface can be read on a scale and the appropriate radius of curvature calculated therefrom Since the radii require to be measured accurately to the 1/2500th part of an inch, it goes without saying that these measuring instruments have to be made with extreme precision

When the lenses have acquired perfectly polished surfaces and when by the tests applied to them they have proved to strictly conform to calculation the next task is to "centre" them This means to so grind the periphery of the lens that the optical axis is at the centre of the cylindrical boundary of the lens The optical "axis," it should be noted, is the line joining the centres of the spheres which form the free lens surfaces.

For testing this adjustment there are likewise two methods, viz., an optical and a mechanical method, and, as before, the optical method is the more accurate of the two It is based in principle upon the reflecting properties of polished lens surfaces The lens which is to be centred is cemented by one of its surfaces to the chuck of a lathe and a flame, or point of light set up at some little distance from it. When the lens is made to rotate the two images of the flame formed by reflection at the two spherical surfaces will be seen to rotate about one another if the optical axis does not coincide with the axis of rotation of the lens. If both are coincident the reflected image appears to stand still. The lens is trued on the chuck, that is to say, it is brought into such a position that the reflected image appears to stand still, by displacing and tilting the lens over the cementing medium. When this has been accomplished the outer boundary of the lens is ground down to a cylinder on the lathe.

Where centred lenses require to be cemented together so as to form a single compound lens, this is done by means of Canada balsam.

Cementing is done by applying a drop of Canada balsam to the carefully cleaned and warmed lenses. They are then placed upon one another, and by gentle pressure air and excess of balsam expelled. When the balsam has cooled the lenses will be firmly united, but they require once more to be trued up on the lathe, in order that the optical axis of the two lenses may accurately coincide The finished combination is then lacquered black at the cylindrical boundary. to obviate reflection of light at the translucent rim. It is now ready to be set in the lens mount

The mounting is mostly done on lathes with treadle motion. The degree of precision with which this operation is performed is the same as that applied in the processes of grinding and polishing, for it will be remembered that the distances between the component lenses of the objective enter into the calculation and must therefore be adhered to within the smallest fraction. Extreme care must also be exercised to avoid any excessive pressure and still more so any one-sided pressure being exerted by the mount upon the lens, as this would give rise to internal strains in the glass, or it might even cause otherwise perfect lens surfaces to be distorted in a more or less pronounced degree When all the various stages in the making of a lens, as here described, have been carried out with rigorous prevision, even then a conscientious optician does not feel entitled to place the resulting product on the market Each finished objective is tested individually by specially appointed lens testers, before it is allowed to enter the world's markets. Once again it is tested for striae, strains and other possible flaws in the glass. and finally it is subjected to a practical photographic trial on the test chart. Also, the focal length, accurately within fractions of a millimetre, is determined for each objective Its agreement with the value prescribed by the calculation furnishes likewise a criterion as to what extent the practical achievement conforms with the calculation Process lenses, as well as mirrors and prisms used in conjunction with these are examined separately in the photo-mechanical laboratory so as to ensure that exceptional degree of optical correction which is needed for this purpose It will be readily appreciated that such a degree of precision in the system of manufacture with its incidental phases of weeding out is quite incompatible with mass production as ordinarily understood, and that this necessarily influences the cost of such products Instruments produced in this way cannot possibly be "cheap" On the other hand, the ultimate possessor of such an instrument has the satisfaction to know that his Objective is equal to its producer's promise.

And it will also be realized that such an instrument

shonld not be expected to answer requirements which are in conflict with the natural laws of optics. Many sins are committed in this respect When the optician's work does not come up to such visions of the impossible, certain enthusiasts are too prone to blame the instrument Thus, it happens very often that an intending purchaser of a lens attaches an exaggerated value to the absence of bubbles, and. indeed, insists that the lenses should be entirely free from these The wish to possess such a lens without a trace of bubbles is intelligible enough, but unfortunately, it is utterly impossible to accede to it for reasons which we have already explained above The optician will certainly take every pains to eliminate any material which might in the slightest degree detract from the practical value of an objective But a few bubbles are not to be reckoned in this category When it is considered that the smallest stop with which a photographic objective is used has an area of 4 sqnare millimetres, say, whilst the aggregate area of the bubbles, contained in an Objective, amounts to about 1/2 square millimetre, say, it follows that the loss of light which may he occasioned by the presence of these isolated bubbles amounts to a negligibly small percentage no more than about 10 per cent of the light-transmitting capacity which the objective has when operating with its smallest stop When, however, we consider that in the majority of cases the objective operates with far larger stops, the loss of light occasioned by the presence of these bubbles becomes utterly insignificant Indeed, in the case of an objective 1 18 inch in diameter its rapidity is only reduced by the 1/9000th part of its rapidity at full aperture We have already pointed out that the presence of small gas bubbles cannot he avoided in optical glass making To the uninitiated these bubbles are particularly conspicuous, and he is inclined to endow them with exaggerated significance Whilst they are entirely unavoidable in the production of the new glasses, they are nothing more than **blemishes which can offend the eye only,** since the loss of light which they occasion is too slight to be appreciated The true amount of this loss may be realized hy a small calculation Let us suppose a certain lens 3 om in diameter to contain 10 bubbles 0 1 mm in diameter This would mean that within a surface of 706 square millimetres a portion of 0 0785 square millimetres large would be ineffective, so that the total loss of light occasioned by the bubbles would be only 1/9000 of the incident or transmissible light. When the lens is stopped down to 1 om. say this opening will contain two bubbles, say. In this somewbat **unfavorable** case the loss of light would therefore be 1/5000 of the total transmissable light These are amounts which have no practical significance whatever, and the most punctilious photographer would certainly not trouble to take any account of them when estimating the required time of exposure in any given case.

You will thus see that manufacturing opticians are well within their logical rights when refnsing to admit the presence of bubbles as reasonable grounds for complaint.

It will have occurred to you that the production of photographic lenses involves a vast expenditure of time and that in a much higher degree it makes very great demands upon manual skill True, in large establishments, as you have seen, the operations are considerably simplified and abridged by the introduction of special machines All the same, in optical manufacture far more is left to the personal skill of the workmen than in any other branch, and this is not likely to be superseded for some time to come by mechanical devices

To be continued in The American Cinematographer for June.

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Welcome, Mr. Gilks

The newest member of the American Society of Cinematographers is A L. Gilks, of the Famous Players-Lasky staff Mr Gilks comes to the Society with a fine record of achievement as a cinematographer and a reputation among his acquaintances for honorable dealing Some of his more recent productions are: "The Gilded Cage", "Beyond the Rocks", "The Great Moment", "Her Husband's Trade Mark", all staring Gloria Swanson and "What's Your Hurry", "Under the Lash", "Excuse My Dust", "Double Speed", featuring Wallace Reid

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Filming a Fish Fight

A Piscatorial Sporting Event in Sunny Siam—The Strangest Sight Ever Filmed by a Camera—A National Sport

By Herford Tines Cowling, A.S.C.

DEAR EDITOR:—That "most thrilling moment" stuff has gotten to be such an old story, that I think most of the boys have headr it; so with your kind permission I want to change the suhject this time to "most unique event." Nor would I dare tell this one for fear of heing nominated for the Ananias club were it not possible for me to produce the evidence in the shape of 150 feet of perfectly good celluloid. I think the most unique event that I ever came across—much less filmed—was that of fish-fighting as a national sport. When I first heard of it from my native interpeterI forthwith accused him of having imbibed too freely of cheap Chinese rice-wine and was looking about for his successor when the chap swore to me by the "sacred white eisphant" to lead me to the actual event or forfeit his honus which I had promised for good service. I finally went with him and this is what I learned and saw:

HERFORD TINES COWLING

Up in the headwaters of the Menam river which twists and winds down to the Royal City of Bankok in the land of ths White Elephant, otherwise known as Siam, there lives a small fish, known to these sons of Buddhism as the Beta. Now the Beta, although only ahout three inches in length when grown, is the spunkiest little "poisson" that ever shook a wicked fin and fighting is his middle name. Just what makes them so "wild" I never discovered, but for many years this littls chap has furnished the chief sporting events for the panung-clad fans of this tiny kingdom. As far hack as anyone could remember fish-fighting had heen the national sport of the lower classes in Siam.

They do not seem to care for horse racing, as introduced hy the British, nor for cockfighting so universally practiced throughout all Malaysia, their neighhors, and hy the Phillppines Islanders, or any other form of Oriental gamhling and chance. But when it comes to fish-fighting a Siamese will wager his last "tical" on his pet fish with a real sporting gusto. Only the males of the species make champion fighters and strange ae it may seem the fish never fight in their native haunts, but only hecome militant when they have been kept alone for a long period of time and probably without sufficient food.

It is the custom to capture the fish and keep them in individual containers away from the sight of other like specimens except when they are heing trained. Daily practice bouts are arranged hy putting two together in a small tank or jar for a short while—just long enough for practice and a couple of rounds after which they ars separated before heing allowed to harm each other. Tiny nets are used for the purpose of conveying them quickly from one hath to another.

It takes many months to train and develop a good fighter. Each man will have a pet Beta which he has petted and fed in his own particular way and upon which he is willing to wager all his savings. Unlike other sports there is no rooting or noise of any kind, with the exception of an occasional grunt of satisfaction or disapproval, silence is maintained throughout the contest. Also the event must take place in the shade as a bright light always frightens the fish.

For the contest a large glass jar containing fresh water from the Menam river is placed in the midst of the spectators and hoth fish are put into this jar. Upon sight of each other the fish snap and hite until one is entirely exhausted. There is a judge, hut never any douht as to the winner, for it's a fight to a finish. Ths first fish to turn turtle and float helly up on the surface of the water is the loser, hoth of the contest and his life, but the winner seldom survives. With such ferocity do they hattle that only occasionally does a fish survive to fight two hattles.

It was a difficult affair to film, impossible during a contest, so I purchased outright two fighting Beta for a moving picture film hout—I believe this is the first ever made. No one there had ever heard of anyone photographing them before, it heing generally conceded as too dark to photograph. After spending many weary hours in an attempt to film them I finally hit upon the schsme of using a large mirror to reflect suniight into the jar AFTER the heat of hattle had developed, and would get as much footage as possihls at one time hefore the Beta would become frightened by the intsnse light and stop fighting, continuing this for a long time. Shooting against a white hackground through the side of a glass jar, this system worked hest and, hy creditahle series including the knockout, all of which cost the expense account sighty "ticals" or twenty Yank dollars,—and was considered will worth the price for a scoop like that.

Tariff Act of 1921

Paragraph 1451. Photographic cameras and parts thereof, not specially provided for, 30 per centum ad valorem; photographic dry plates, not specially provided for, and photographic and moving-picture filme, sensitized hut not exposed or developed, 20 per centum ad valorem; photographic-film negatives, imported in any form, for use in any way in connection with moving-picture exhihits, or for making or reproducing pictures for such exhibits, exposed, whether developed or not, and photographic-film positivs, imported in any form, for use in any way in connection with moving-picture exhibits, including herein all moving, motion, motophotography, or cinematography film pictures, prints, positives, or duplicates of every kind and nature, and of whatever substance made, 30 per centum ad valorem: **Provided**, That upon the importation of photographic and motion-picture films negatives taken from the United States and exposed in a foreign country hy an American producer of motion pictures operating temporarily in said foreign country in the course of production of a picture 60 per centum or more of which is made in the United States the duty shall he 25 per centum ad valorem, and the Secretary of the Treasury shall prescrihe such rules and regulations as may be necessary for the entry of such films or film negatives under this provisn: **Provided, further**, That all photographic films imported may he imposed by the Secretary of the Treasury.

They Like Phil.

When the new Board of Governors of the A.S.C. elected April 3rd, 1922, met to elect officers on the night of April 11th, Phil H. Whitman was unanimously re-elected secretary.

Mr. Whitman rendered valuable service to the Society during the past year and his re-election was a deserved compliment. He is, besides, a member of the Board of Editors of The American Cinematographer and the clever writer of the "Pans and Tilts" page. He has for years been a member of the Universal staff of cinematographers doing expert work along special lines of research

TITLES ART BACK-GROUNDS

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HOLLY 482

It Is Hard to Believe

That the general manager of a producing company would fire his chief electrician for having too many men, when there were only thirty men to sixteen companies, or a fraction of a man to each set.

That when you have a big hotel lobby set and not enough people to make a showing in it you can take a close up of two or three people signing the register with three or four hundred names on it or, not having a suitable character for a cigar girl or telegraph operator, you can put up a sign "Out to Lunch," and get away with it.

That an assistant director who does not leave the studio for location with his company two minutes after the time he has the location cars called will have to pay, from his salary, the waiting time of the said cars.

That assistant cameramen must, from their big salaries, make good all time they hold up the troupe by an occasional bone-head trick.

That, if a report comes to the company saying that the first seven scenes of the previous day's work are lost and you assure them that every thing was turned in, and, when they are found, you are told that after a very thorough search they were found still in the hypo,—I say, it is hard to believe that the G. M. doesn't need to take a correspondence course.—Contributed.

Mitchell Cameras Ready

The Mitchell Camera Company have installed a radiophone outfit to receive orders for Mitchell cameras which are now ready for delivery. The Mitchell Company is now shipping cameras to the east to fill orders booked six months ago.

In Farthest North

Watterson R. Rothacker, Chicago practical picture producer, has received word of history's nearest-to-the-North Pole movie show. It was on Victoria Island hundreds of miles beyond the Arctic Circle. The films and portable projection equipment were carried 300 miles by dog sled. The Esquimos were at first frightened, thinking the shadow figures were ghosts. The program was a "warm" one—three pictures visualizing the American coal, sulphur and asbestos industries which were produced by the Rothacker Film Co. in co-operation with the United States Bureau of Mines.

Photographed By

(Continued from Page 2.)

Thursday and Friday, "Molly O"—Photographed by Fred Jackman, A.S.C. and Homer Scott, A.S.C.
"The Joy Killer"—Photographed by Robert Doran, A.S.C.
Saturday, "A Sailor Made Man"—Photographed by Walter Landin, A.S.C.

TALLY'S—"When Romance Rides"—Photographed by Gus Peterson, A.S.C. and Wm. Edmund.

WILSHIRE—Tuesday and Wednesday, "Her Husband's Trade Mark"—Photographed by Alfred Gilks, A.S.C.
Thursday and Friday—"Travelin' On"—Photographed by Joseph August, A. S. C.
Saturday, "Morals"—Photographed by James Van Trees, A.S.C.
Sunday, "The Seventh Day"—Photographed by Henry Cranjager, A.S.C.

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The Einstein Theory in Films

Motion Pictures to Make Clear What Few Have Been Able to Grasp—A German Production After a Year's Work

BERLIN.—Any human mind able to understand that one and one are two, will be able to assimilate the celebrated Einstein theory after once witnessing the motion picture which German scientists have just completed after a year's hard work, according to the producer's claims.

For the first time, April 2, at Frankfort, will be shown a movie not of men and action, but of a theory. And, the producers say, this movie explains in simple pictures the most baffling principles in the mathematical philosophy which, heretofore, has been thoroughly understood only by Einstein himself.

FRIEND WROTE THE SCRIPT.

Although Einstein authorized the film, the actual producer is Professor Nicolai, a close friend of the scientist, and former physician to the ex-kaiser. Nicolai wrote the "script." Interest in the Einstein theory, Nicolai said, was so great that it became necessary to give the public an exposition of its principles, particularly because of the general misconceptions resulting from attempts to elucidate the problem by unqualified minds.

"But even the uneducated man or woman will grasp the most intricate idea from the film," he said.

The picture is more than 6,500 feet in length.

DIVIDED INTO THREE SECTIONS

Einstein's "plot" is divided into three sections. The first presents a general conception of relativity based on everyday incidents which anybody can understand. The second is an explanation of the problems of time, space, and ether. The third reveals a solution of the problem based on Einstein's own theory.

The present edition is limited to a single film, intended for use as a scientific lecture. Popular copies are now being prepared to be shown throughout the world.

EINSTEIN'S THEORY IS ABSTRUSE

Professor Einstein's theory of relativity belongs in the most abstruse field of pure mathematics, and the main difficulty in giving an account in simple language is that the whole theory is a revolt against "simple language." While the Einstein theory, scientists say, in no way invalidates the law of gravitation discovered by Newton, it does overthrow Newton's theory that light waves travel through space in straight lines. Einstein alleges that a beam of light has momentum, also weight, and is subject to deflection when passing through a gravitational field.

Einstein also contends that there is no such thing as "fixed position" for a body in space, therefore all motion is relative, so that there can be no permanent, absolute standard against which motion can be measured. The velocity of a moving body is only relative to the velocity of some other. There are two ways of measuring a moving body: either by taking its measure on the moving body itself or by observation from another moving body. Each method of measurement gives a different result, it is said by scientists.

Here He Is

Charile Rosher, A.S.C., cinematographer de luxe, attached to the entourage of no less a luminary than Mary Pickford, is back on the lot tuning up his Mitchell to "shoot" Mary in her next picture, after a six months' sojourn in Italy. Mrs. Rosher accompanied him.

Mr. Rosher had a great time in the land made famous by Tony Gaudio and Sol Polito, but he is glad to get back to Mary, Hollywood, the pepper trees and palms.

He will tell the story of his Italian sojourn in an early issue of The American Cinematographer.

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Cold Light

Some Suggestions as to Experimentation With the Light that Has No Heat. More than One Hundred and Fifty Species of Animals are Light Producers

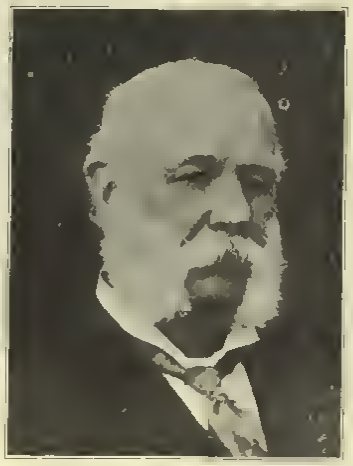
By Dr. Gilbert Ellis Bailey.

[Since Dr. Bailey wrote this article it has been announced that Mr. N. J. Ritterrath of Los Angeles has developed a "cold light" with which he has been able to photograph microscopical life so small that it could not be detected by the unaided eye, the film showing a close up large enough to fill the screen. This "cold light" of Mr. Ritterrath is developed by extracting the red, violet and all other rays, save alone the white rays, from a source of light. This light may be used in motion picture projection by attaching a "ray cooler" to any ordinary projection machine. With the lens at the center showing 6250 degrees the heat at the gate would show only 70 degrees whereas ordinary light would show 1200 degrees at the gate. This new light will doubtless prove revolutionary. Mr. Ritterrath believes it will supplant the X-Ray, and Mr. William Dresseer, president of the Bausch and Laumb Co., of Rochester, says it will make a tremendous saving in electric power. It would require pages to tell all the wonders of the new light. Mr. Fred E. Keeler, of the Keeler Clay Products Co., of Los Angeles, has co-operated with Mr. Ritterrath in the financial and commercial aspects of the invention which they have arranged to place upon the market in the near future.—Ed. Note.]

Is this dream of the cinematographer about to be realized? The latest report is that an Italian has invented and exhibited a portable lamp lighted by "wireless waves" and that it can only be extinguished by "tuning out." The base of the lamp contains chemicals that are excited by the waves, thereby producing the light.

What a snap it would be if studios were lighted by wireless without cost except to the newspaper that is broadcasting grand opera and soap ads.

Nature shows that is is possible to have light without heat and furnishes many examples—the Aurora that enlivens life in the far north; the Magellan clouds of the far south; the zodiacal light; and the diffused light of the Milky Way that the Chinese call the "river of the sky."



DR. GILBERT ELLIS BAILEY

Over 150 species of animals are light producers, and anyone of them may reveal the secret. Then we will know what makes the wonderful phosphorescent light of the tropical seas, the collective light of the infusoriae on the surface of the water.

Cold light is not confined to the sea life and animals. Some gems are "phosphorescent" after being exposed to sunlight; even snow has this property. The tuberose and moonflower emit flashes of light. Clouds glow under electric stress. The clear night sky of our deserts seem charged with a luminous star mist.

The most familiar example of light without heat is the firefly. In the tropics one may read the dial of a watch by fireflies confined in a bit of mosquito netting. Some South American Indians fasten fireflies to their feet when following the trail. In Central America I have danced with senoritas who had fireflies fastened in their hair by threads, giving such a dazzling effect that I could hardly watch my step. The fireflies of Siam settle upon the trees like a fiery cloud. In Brazil fireflies have "the brilliancy of stars fallen from the firmament and floating without a resting place."

"Butterflies wings are gaudy,
Lightning-bugs are flame—"

Cold Flame, that is worth further experimenting with.

If the secret of the firefly were known a child turning a crank could furnish the energy to light an entire electric circuit, as compared with the enormous energy required now.

Permit a few suggestions. Is this light weak? Find a way to amplify it. Years ago the footsteps of a fly were magnified by the newly discovered microphone, until the sound was like the old cow pulling her foot out of the mud.

The metal selenium is very sensitive to light. Experiment with it. Chemists have recently proven that one form of light is a chemical product for it is decreased by the action of nitrogen and increased by the action of oxygen, the product being carbon dioxide. The major difficulty in experimenting with fireflies was that the "illuminating part" was a transparent semi-jellied wax that could not be kept long for experiments. Substitute an artificial product. To-day all kinds of light and heavy oils are transformed into jellies and waxes by the action of a current of hydrogen in the presence of a catalyzer like nickel.

Paints visible in the dark, that would light up the lost keyhole, were made before the Volstead Act ruined the market. They were made of oyster shell, sulphur and phosphorus. Only the outer edges of the secrets of the wonderful radium paints have been touched upon. There is a fine field open for experimenting with vaccum tubes and emanations excited by wireless waves. My chemical library is at the service of any of the "boys" who wish to experiment.

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The American Cinematographer

Mr. Griffith is a great director, a credit to his profession, an ornament to his art and a builder of vision. Readiness to award honor to whom honor is due should be one of the graces of every great man—especially of the artist. Having in mind these things one cannot help wondering why the photographers of "Orphans of the Storm" were not given screen credit.

Motion pictures in the home is already a fact, no longer to be wondered at. The Cinemaphone, a combination of phonograph and motion picture, is one of the newest offering along these lines.

The secret of the radio craze may be found in the fascination the UNSEEN has for everybody. The idea of pulling down tangible things out of the blue appeals to the imagination as does nothing else. Slowly but surely is Material Science pushing back the barriers of the UNSEEN and the further it goes the nearer will the scientist find himself to the God of nature. This radio craze is, therefore, a healthy sign.

The life of the Motion Picture Industry may be found in the great body of technical workers within the studios and laboratories. By the progress of these may be measured the progress of all branches of the cinema art.

The American Society of Cinematographers sends greetings to the Society of Motion Picture Engineers in convention assembled at Boston. May their usefulness, fame and fortune wax greater with the years, to the glory of the motion picture industry.

Now that nearly everybody has taken some sort of a smash at motion pictures and motion picture people may we please be permitted to take a long breath and start all over again. It will take quite awhile to gather up the pieces, but in time we hope, by co-operation, vision, faith and patience, to make the old industry look almost natural again.

It is not censorship that hurts so much as that censorship should have been considered necessary.

The term "star," as applied to motion picture players, has been so brutally misused by the press that it is eternally discredited as the title of a premier actor or actress. Players such as Pickford, the Gishes, Farnum, Hart, Chaplin, Fairbanks and other true headliners would seem justified to sue for libel any paper referring to them as "star."

Upstageness in anyone is as unpardonable as uncleanliness and quite as offensive. If the upstage one would only stop long enough to inquire of himself what he has contributed to the sum total of the common good of the world his salvation might be at hand. When, therefore, the upstage one be tempted to do a little upstaging let him pause long enough to ask himself these questions: Did I invent the wheel-barrow, the safety pin, the lead pencil, the tea spoon, the napkin, the typewriter, the steam boiler, the sewing machine ,the tooth brush, the axe ,the automobile, the hook and eye, the pin, the linotype, the electric light, the bath tub, the B V D, the ox cart, the railroad, the printing press, or anything else? Have I ever painted a picture or written a story or a song or a poem? Have I ever done any act of real self sacrifice for the good of another? Have I ever planted a tree, or flower or a vegetable or a field of corn? Have I ever been kind and helpful to the birds and horses, cats, dogs and other animals? Have I ever smoothed the way for the aged or made a child to smile? Have I in any way added to the wisdom of the world and am I an asset or a liability to it? Is the world any better for my having lived in it or do I merely occupy the place on earth that rightfully belongs to the dog fennel and the Indian turnip? Some such catechism as this may help the upstage one to set himself aright, and, by the way, there is just as much upstageness around the motion picture studios as anywhere else.

George Arliss, the distinguished English actor, who was the featured player of "Disraeli," is going at it right. He is personally canvassing the exhibitors of the country to ascertain if possible what type of picture would meet with the widest approval of their patrons.

The American Cinematographer cannot too strongly commend the Society of Motion Picture Engineers upon the showing they are making along new lines of research for the betterment of motion pictures. At each successive meeting the members report new achievements and steady progress toward the ideal of perfection set as their ultimate goal. Their work more than that of any other of the many groups that go to make up the workers of the industry reveals the amazing diversity of the elements of picture production and the almost infinite ramifications of the cinema art. The American Cinematographer congratulates the S. M. P. E. upon the showing made during their brief career and assures them that it will ever be on the alert to co-operate with them that it will ever be on the alert to co-operate with industry and a buttress of its stability.

Re-Elected

Fred W. Jackman, who has been president of the A. S. C. since April, 1921, was re-elected at the annual meeting, April 11th, 1922.

Mr. Jackman's re-election is a tribute to his ability and popularity as a presiding officer and a compliment to a cinematographer who has always been "a workman that needs not to be ashamed."

He has dreams of greater achievements by the A. S. C. and will give his best efforts to making them come true in 1922.

How They Get the Snow Stuff

The E. I. E. S. Can Make a Blizzard While You Wait—Some of the Equipment Necessary to Manufacture a Snow Storm.

THE beautiful snow looks good on the screen, but it is no joke to shoot snow stuff

We hear of the movies going to Big Bear or Truckee to get the white stuff, but we do not hear much about the men who really make it possible to get it.

There may be entire countries and states covered with snow, but there isn't always a blizzard with driving snow ready to be filmed.

It is the business of somebody to make a blizzard to order if the script calls for a blizzard, but the manner of staging the blizzard is not shown on the screen. All we see there is the snow driving before the gale and the hero or the heroine or both struggling along in it.

In a snow picture you are first shown the trackless waste, usually in a pine forest; then a frontier post, or trading camp, or village, with the trails leading thereto, but the blizzard is reserved for the big punch and here's where the storm-maker comes in.

Now the storm-maker or blizzard puncher is usually a member of the Electrical Illuminating Engineers Society, for blizzard making is their job and the West Coast members of the organization have had so much of this to do that it is all in the day's work with them

In the filming of a recent Lasky picture Speed Hostetter, of the Cinema Studio Supply Company, was called upon at 4:30 p.m. to have a crew and storm ma-

Fig. 1

Fig. 2

chines aboard tha 6:15 train for Truckee That meant fourteen men and a machina so big that it raquired sixteen head of horses to move it 300 feet through the snows from the railroad car to location at Truckee The weather was twenty-four dagrees below zero and the machine had to ha kapt "thawed out" hy the use of oil stoves and tarpaulins.

Figura 3, showa a 350-ampere electric genarator mounted on a Curtis wind machine capabla of making as convincing a hlizzard as you aver were in and with power sufficient to pull ten Winfield-Kerner aide lights right out in tha open.

When tha machine is backed up to a snow drift whare the whirling propeller can pick up loose snow, the result is a ready-made tornado that can almost carry a man off his feat.

Figure 4 is a close up of the generator, showing that it is no toy, and Figure 2, shows part of the crew who operatad tha storm machine and kept it from freezing, while Figure 1. is a snap shot at the big 200-horsepower Curtis wind machine with double propellers nina feet in diameter The pictures wara all shot by "Bill" Nye, at Truckee

Smaller machines may he used for rainstorm making, hut sand storms usually require vary powerful machines to get good results.

Motion picture making is bacoming mora and more a matter of engineering and this branch of the industry is quite as important and interesting as any other Just keep an eye on the E. I. E. S. and tha S. M. P. E. They are coming fast

Fig. 3

Hellup!

HE—I saw a fina movie last night: new ona called the S-h-r-i-e-k.

SHE—And who piayed tha lead

He—A new girl—nevar saw har hafore—I think her nama was Jessie Lasky.

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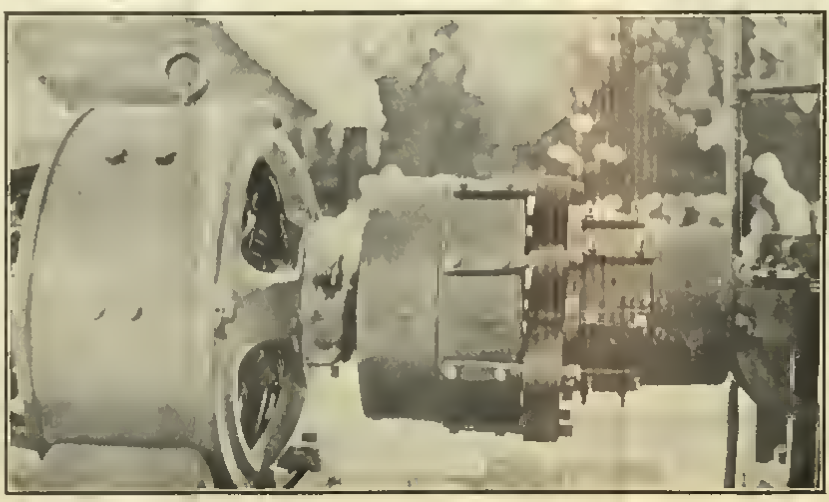

Fig. 4

What Is a Good Negative?

Abe Schoitz, A S C., one of the best laboratory men on earth when asked the other day to write an article for The American Cinematographer on the subject of "Good Negative," repiled that he had been so buey handiing negative during the iast fifteen years that he had had no time to write about it But after a iittie coaxing he said:

"What is the most important thing in making a picture piay that very few peopie see or think about?" It is the negative This must he a surprising statement to an average man in the audience, who thinke no more of the negative or the man who handles it, than he does of the miner, whiie warming himseif in front of a coal fire Yes, **Negative is the Thing.**

It begins its existence after the scene is ali rehearsed and the man behind the camera is satisfied with the iighting, composition, etc Neediess to say, it is up to the above mentioned man behind the gun to start the negative right on its career, for it is like everything eise in creation subject to the iawe of heredity and reflects ali the virtuee as well ae faults of its creator's careiessnoee, artistry, ignorance, painstaking effort and so on So then, assuming that it hae been given the right start it is yet up to development (its environment, so to say) to make a good negative

Now then, what is a good negative? Tbe following formula should satisfy the most exacting: Negative that hae all the gradations of light and ehade; that has enough body to require fairly strong light in printing and is not so contraety that the extreme points of gradation shall have to be sacrificed. That ie: If the dense part needs so much iight that it submerges thq shadows it ie then of perfect, harmonious negative

So it ie thie result that every conscientious iaboratory man ie etriving for and shouid achieve provided he he given support and co-operation of the most interested party—the cameraman!"

Milner, an Officer

Victor Milner was elected second vice-president of the A S C. at the annuai meeting, April 11th, 1922. Mr. Milner was one of the charter members of the A. S C and hae aiways been active in its councils He is a veteran cinematographer with many studio successes to his credit and a wide experience in the field as a news and commerciai photographer Mr Milner's present affiiiation is with Universal

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St Louis—Central National Bank Bldg.
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N. B. of R. Selections

The National Board of Review has selected the following feature photoplays as especially suitable for exhibition for Mothere Day and Motheis Week beginning May 14th—

THE OLD NEST—Goldwyn.
OVER THE HILL—Fox.
ONE MAN IN A MILLION—Robertson-Cole
HUMORESQUE—Famous Players Lasky.
HOMESPUN FOLKS—Associated Producers 1st National
OLD OAKEN BUCKET—Wid Gunning
THE GOOD PROVIDER—Famous Players Lasky
YOUR BEST FRIEND—Warner Bros.
TURN TO THE RIGHT—Metro.
DEVOTION—Associated Producers 1st National.
DOLLARS AND THE WOMAN—Vitagraph
MOTHER O'MINE—1st National
SCRAP IRON—1st National
HAIL THE WOMAN—1st National

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The Beginnings of the Cinema

Birth of the Final Form of the Motion Pictures—The Work of C. Francis Jenkins

By Special permission of Ben J. Lubeches. An excerpt from his book "The Story of the Motion Picture."

WHILE Robert Paul and others in England, Lumiere in France, Edison in America, were known to be working on moving picture projection machines, a young man, a stenographer in a division of the Treasury Department at Washington, was spending all his spare time at a bench and in the back-yard of his boarding house in mysterious occupation The results of his labors he shipped to his home in Richmond, Indiana, where he was soon to go on a vacation Arriving in Richmond he announced to his friends and relatives that the next day he would demonstrate to them the invention which had kept him so busy for two years. The young man was C Francis Jenkins, and his invention was the first crude model of the present moving picture projection machine and possessed all the essential features of the present day machine True to his promise, the next day, with electric current borrowed from a trolley wire in the adjoining street, and run thru an improvised transformer, he showed the wonders of his machine to a group of his townsmen. The film was of "Annabelle the Dancer," and was hand colored, rather on the overdone side. All this happened on June 6, 1894 Those in the small audience did not know whether they had been tricked, or hypnotized. or just what had happened They made sure that the real dancer was not there in person; that the machine was real and material; that the wall behind the sheet used for a screen was sound and normal, and so, more bewildered than ever, they left, little realizing that they had witnessed the first exhibition of moving pictures, in every important detail as we know them today. Soon after his return to Washington, Jenkins met, at a school of electricity he was then attending, a fellow student who was interested in animated photography This was Thomas Armat To Armat, Jenkins confessed his financial inability to continue his exeprimenta, and they entered into an agreement to continue them together About ten months after the showing by Jenkins in Richmond, he two put forth a machine supposedly an improvement, digressing in some details from Jenkins' original model and reverting to some of the mechanical features of Edison's Kinetoscope This effort was a failure, and altho Jenkins was much discouraged, spurred on by Armat, the two really improved Jenkins' original model and the joint application for a patent on this intermittent machine was made August 28, 1895, and later granted

Jenkins and Armat exhibited these machines, with films of their own make, at the Cotton States Exposition in Atlanta late in 1895. Despite the efforts of an announcer or "barker," the people would not pay twenty-five cents to see something they had never heard of and did not believe could be. With failure confronting them, Jenkins and Armat decided to invite the doubters in free and ask them to pay the quarter on going out if they thought they received the value. Nine-tenths of them paid and told others and soon it looked as if the show would be a great success, when a fire broke out and the concession, including the machines, burned to the ground. By this time Jenkins was quite discouraged and differences which ended in a multiplicity of lawsuits arose between the two partners

Late in December of 1895, Mr Jenkins read a paper before the Franklin Institute of Pennsylvania, describing his inventions At about the same time Mr. Armat was showing a model of the machine, somewhat remodeled, to the selling agents of the Edison interests in New York, while Mr. Edison was doing some work on a projecting machine of his own. In the spring of 1896, Jenkins again exhibited his machine, on the Board Walk at Atlantic City, directly opposite an exhibition of the Edison "peep-hole" Kinetoscopes. With the choice of looking at moving pictures individually and by standing up to a small peep-hole, and of sitting down comfortably with others and viewing them on a screen, patrons quite naturally chose the latter, and just as, in the Chicago Exposition, the Kinetoscope had driven the crude Zoopraxiscope of Muybridge to the scrap heap, so here, in Atlantic City, the projection machine of Jenkins caused the scrapping of the peep-hole Kinetoscope. The poor patronage of the Kinetoscope at Atlantic City brought about negotiations between the Edison selling agents and Armat, with the result that the Edison Company agreed to manufacture and market the machine under the name of the Edison Vitascope-Armat Design. At this time the Jenkins-Armat joint patent had not yet been granted and Armat succeeded in buying Jenkins' interest in the patent for $2,500,—besides woes, troubles and a medal, all that Jenkins ever received for the invention of the moving picture projection machine of today. And against the award of the medal, the Elliot Cresson Medal of the Franklin Institute, Mr. Armat entered protest claiming that he and not Jenkins was really the inventor of the moving picture machine After a careful investigation, however, the medal was awarded to Mr Jenkins.

How the Jenkins-Armat machine came to be called the Edison Vitascope shows a curious working of business psychology. Of course, neither Mr. Edison nor his company has ever claimed that Mr. Edison was the inventor of the machine. Notwithstanding this, the public has often labored under that impression. When the negotiations with Mr. Armat were begun, it was pointed out to Armat by the Edison selling agents that Edison had been working on a projecting machine, that probable users of the projecting machine were waiting patiently for Edison's announcement, that no machine put out under an unknown name would succeed without long delay on account of this waiting for Mr Edison whose prestige commanded respect and tended to depreciate outside efforts in the same direction as he was working They told Armat that if his machines were to sell widely from the first, they had in some way to be connected with Mr. Edison's name, to keep within the actual truth and at the same time take advantage of Edison prestige—so came about the resulting name of "Edison Vitascope-Armat Design," the machine being manufactured in the Edison shops on a royalty baels

Altho the Jenkins machine was the first with which an exhibition of the present type was shown, in the two or three years during which this machine was developed and finally marketed as the Edison Vitascope, literally dozens of more or less similar machines were patented in England, France and Germany, all using different sizes of film with various styles of perforations. The great expense and greater inconvenience of being able to use films of one special make only, on any particular machine, however, soon brought about a standardization in size and perforations following the Edison and Jenkins ideas, so that now, film made anywhere by any company may be used on any machine on the market In this way have moving pictures gained a most widespread and almost unlimited audience As for the machines themselves, later years have merely brought about improvements on the Jenkins model of the early ninaties.

From the description of the few essentials in the present day moving picture machine, it will be seen how this machine is merely the gathering and development of principles discovered or invented, some of them quite long ago, by different people The actual projection system is similar to that of the ordinary magic lantern; a source of light, a condensing lens, and an

objective lens. The picture, instead of being on a single glass slide is repeated many times on a long flexible ribbon of film, perforated on each edge. This film runs off of one reel onto another, but does not move continuously. By means of sprocket wheels and cams engaging the perforations in the edges, the film is moved about ¾ of an inch, the length of one picture, and stops for an instant, then moves another step and so on. At the objective lens is a revolving shutter with several openings in it. As a film picture stops before the lens, an opening of the shutter stops at the lens also, the light shines thru and the picture is projected on the screen. When the film is moving, the shutter obstructs the light and the screen is dark. This intermittent showing of picture and darkening of screen takes places from sixteen to twenty times a second. Each picture shows a slightly different phase of motion or position, and persistance of vision bridges over the dark periods and blends the pictures. The taking apparatus is essentially no different from the projector. The condenser and source of light are of course unnecessary. The objective lens makes a series of negatives on the strip of film; by light, strips of positives are printed from this negative. These positives are the films used for exhibition. When the perforations in the film become worn, when the moving parts of the projecting machine work with a great deal of play on account of wear or looseness, or when the whole apparatus is unsteady and vibrates, the picture on the screen shows with that unpleasant "flicker" which is so trying to the eyes. Of course all these defects may be present in the taking apparatus or camera and then it cannot be remedied in presentation. The effect of exaggerated unsteadiness of apparatus is well shown in pictures taken from the platform of a train or from a moving automobile.

With the perfected machine both for taking and projecting, began the rapid development in the making of the pictures themselves.

L. Guy Wilky

L. Guy Wilky, who has been a member of the Board of Governors of the A. S. C., was elected at the annual meeting, April 11th, 1922.

Mr. Wilky has long been one of the active workers in the A. S. C., and is a credit to the organization. He has a long and creditable career to his account and as first vice-president will be able to render valuable assistance to Chief Jackman.

Mr. Wilky is a member of the Lasky staff of cinematographers.

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New Board of Governors of A. S. C.

At the annual meeting of the members of the American Society of Cinematographers held on the night of April 3, 1922, a Board of Governors was elected as follows:

John Arnold	Philip E. Rosen
H. Lyman Broening	Homer A. Scott
Gaetano T. Gaudio	John F. Seitz
Frank B. Good	James C. Van Trees
Fred W. Jackman	Gilbert Warrenton
John Leezer	Philip H. Whitman
Victor Milner	L. Guy Wilky

Jackson J. Rose

The new members are John Leezer, Victor Milner, Jackson Rose and Gilbert Warrenton.

The Board of Governors organized, April 11, by electing officers as follows:

Fred W. Jackman, President
L. Guy Wilky, First Vice-President
Victor Milner, Second Vice-President
Gilbert Warrenton, Third Vice-President
Jackson J. Rose, Treasurer
Philip H. Whitman, Secretary

Expedition to the Holy Land

HARRY LEVEY, president of National Non-Theatrical Motion Pictures, Inc., is sending a motion picture expedition to Egypt and the Holy Land to secure a series of Biblical, historical and geographical films to form a comprehensive film record of the sacred and historic places of Egypt, Palestina and Mesopotamia.

The expedition which starts this month will be in charge of M. J. Wiss, of California, who has had a long and varied film experience and is an expert camera man. In addition to visiting Egypt and Holy Land the party will also visit Poland, Rumania and other countries in that section of Europe where the geography and economic conditions have changed greatly since the World War, and of which no very accurate, historic and up-to-date record is available. These films will be fitted into the World Geography series being built up by National Non-Theatrical for use in public schools, churches, colleges and clubs.

To go to church and see the Holy Land will now be possible. What student of the most widely read book in the word, the Bible, has not longed to make a pilgrimage to the places mentioned and how few have been able to make such a journey.

The motion picture's greatest mission to man probably lies in its ability to bring the world to those who can not travel forth and see it for themselves.

In many of the out-of-the-way places the people are living to-day much as they lived 1900 years ago. They retain many of their old world customs and primitive methods of living. All of these will be shown in graphic form. The Bible stories will take on new life, new vigor, a new reality. The largest church going population will be increased by the desire to see the places of which they had only read and had come almost to believe existed only in the pages of the Bible. Students of history, of literature, of civilization will find much inspiration in such pictures.

A few of the Bible famous places which will be included in this most comprehensive series will include the land of Judea, of Jericho, the Jordan, Gath, Zorah, Gaza, the Valley Elah, St. Paul's Valley, Samson's Tomb, Ashkelon and the Sea, Ashdod, Ekron, Beth-Shemesh, Hebron, The Hill Country of Judea, Carmel, Bethsheba. The Land of Goshen, the Nile where Moses was found, Memphis and Rhodes, Cairo, Alexandria and Heliopolis, the Pyramids, the Sphinxes, the site of Pharoah's Palace, tha Road to Jericho, The House of Zacchaas, scenes on both banks of the Jordan, Mount Nabo and Mt. Gilead, Giba and Rimmon and Bathal and Ai and Shiloh and Samaria, Jezreel and many more too numerous to mention here.

All the films secured by the Wiss Expedition will be released exclusively through National Non-Theatrical exchanges.

The Cinema College or Normal

This Contributor Sees the Educational Picture Coming Fast—A Normal School for Teachers of Film Subjects an Immediate Possibility

By John Leezer, A.S.C.

No invention, no discovery, has become so universally popular in so short a time as the animated picture. It may be premature to say that motion pictures constitute man's greatest achievement, nevertheless when we consider what they have already accomplished, future possibilities seem unlimited. Their entertainment value is already established and, while the foremost educators recognize the value of motion pictures as an educational force, we are safe in saying that future realization in this direction will far exceed present expectations. In this field the animated picture will reach its greatest usefulness, yet, whatever is to be accomplished will come slowly as compared with the advance made in the entertainment field, for teaching is a serious business and can only be accomplished by sober and intelligent fore-thought.

This is the "Speed" age. Intensive is the word. It applies to all of man's activities and he finds the motion picture his chief accessory. It will not only make the boy or girl in school more thorough because of better understanding, but this knowledge will be gained more quickly. The longer time required for a child to pass through the different grades, the more expense be le to the tax payer. But aside from the matter of speed, the fact remains that for thoroughness this method is far superior to any extent.

Outside the ten per cent, which is the average of failures, the students with highest marks do not seem to have gained as much knowledge as those marks would indicate. In fact a few simple questions bearing on subjects commonly supposed to be taught in the public schools, would be extremely embarassing to the average high school graduating class. Some schools require only a certain number of points in the aggregate to graduate, therefore, if it be optional with the student as to the character of studies he takes up, he will in many cases take no more of the solids or more difficult subjects than is absolutely necessary. The student who gets the most he can out of his public school instruction is a most exceptional boy or girl. The animated picture text will improve the "optional" study privilege we have referred to, only in so far as it makes the "dreaded" subject more illuminating and inviting.

There is another and older class of students we must not overlook. It is the unfortunate class of men and women made unfortunate either by the lack of application or inadequate methods of instruction when they were in the public schools. This class of students is also made up of men and women who for various reasons were unable to attend school regularly or at all, being largely of foreign birth. I have reference to the night school class. They are trying to regain lost opportunities and make new ones at one and the same time. Consider what the future holds for them from off the screen. Their ambitions will be realized with half the effort and time expended. The motion picture speaks a universal language, readily understood by either Russian or Greek, and I feel sure that there are many of us who would improve the opportunity to brush up on subjects neglected in the past or to keep up-to-date on developments scientific or otherwise. We would get this from popular lectures at little expense of time and money through community theatres and clubs.

The eye is the most direct and less obstructed route to the brain, therefore, if the subjects are not very carefully prepared the student will learn that which is harmful just as quickly and just as thoroughly as that which is good. In other words the animated picture as a medium of suggestion is so thorough and so rapid that a misleading thought gained from this source is most difficult to eradicate. Correct methods of preparing subject matter will be arrived at by experiment, but experiments of this nature cannot be hurried. A decided improvement must occur in the matter of titles, the proper length of subjects for the different grades must be determined. No doubt some improvement will be made in projection apparatus, that eye strain may be eliminated entirely. The tint or tone of the print best calculated to reduce eye strain will also be decided upon. The cinematographer will experiment with lightings and angles from which certain subjects must be photographed so that they will "get over" on the screen.

All these and many other problems sure to come up must be worked out, and not on paper but in a work shop. The work shop will be the Cinema College or Cinema Normal, buildings suitably equipped to carry on exhaustive experimentation and final production. The work of preparing subject matter must, of course, be left to experienced educators while the technical processes through which this matter must go to reach the screen will be in the hands of men skilled in those branches. Teachers will be able to visit the nearest Cinema Normal during vacation periods for instruction in the best methods of teaching by animated pictures and to become familiar with the handling of film, etc.

While, in many instances, fortune seems to come through chance, in the final analysis we find it due to knowledge that unlocks all doors and opens all ways. It must be disseminated quickly and thoroughly and the animated picture as a medium meets these requirements. A new and ever widening field presents itself to the man of means, the educator and the cinematographer.

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DeBrie

L. Guy Wilky, A. S. C., had the time of his young life filming that bull fight in the City of Mexico. He got everything that ever happens in a bull fight including the goring of a picador. Guy says that after shooting 5,000 feet of it at short range he knows what Mark Twain meant when he said, in telling of a bull fight he had attended, that "the only gentlemen present were himself and the bull."

Allen M. Davey, A. S. C., has gone to Sacramento for a six weeks' engagement.

Alois G. Heimerl, A. S. C., is assisting Chief John S. Stumar in the photographic department of the American studio at Santa Barbara.

Walter Lundin, A. S. C., who has shot every Harold Lloyd comedy since Hal Roach's famous player began to affect the horn rimmed goggles, recently finished "Grandma's Boy," a five-reel feature which is said to be the best production ever made by the Roach-Lloyd combination. Mr. Lundin's work is as usual unexceptionable.

The Detroit Motion Picture Corporation is building a studio 100 x 318 on Jernier Road, Detroit. Frank L. Talbot is president. The new company will make special features.

Charles Van Enger, A. S. C., has gone to London with Maurice Tourneur to film Hall Caine's "The Christian" for Goldwyn.

Harry Gerstad, A. S. C., is at Truckee, with Roy Stewart Productions.

Paul P. Perry, A. S. C., is leaving, May 1, for Santa Barbara with the Penryhn Stanlaws Productions to make "Pink Gods." In the cast are James Kirkwood, Bebe Daniels, Anna Q. Nielson, Raymond Hatton. Paul expects to be gone several weeks.

Jackson Rose, A. S. C., is holding the premier set up on "They're Off," a racing story under direction of Stuart Payton, at U. Marie Prevost is the featured player.

Charles E. Schoenbaum, A. S. C., is filming "The Siren Call," at Lasky's, under direction of Irving Willat. The featured players are Dorothy Dalton, David Powell and Mitchell Lewis. The largest dance hall set ever built will be a feature of this picture.

Paul Powell is doing "Between the Worlds", with Agnes Ayers playing a triple role—an 1850 character and a 1920 character, and at the same time playing the 1850 spirit in the 1920 episode. There will be two or three reels of triple exposure, split screen and trick photography in charge of Harry Perry, cinematographer. Cast includes Milton Sills, Casson Ferguson, Bertram Grassby and Sylvia Ashton.

L. Guy Wilky, A. S. C., is working on William C. DeMille's production "Nice People"; cast includes Wallace Reid, Conrad Nagel, Bebe Daniels, Julia Faye, Clair McDowell, Rural New York state.

George H. Melford and company are in Oxnard, California, where he has established camp to do "Burning Sands", by Olga Printzlau. The cast includes Milton Sills, Wanda Hawley, Louise Dresser and Winter Hall. Miss Nan Harron has charge of continuity. Bert Glennon is cinematographer. Mr. Melford should feel at home in Oxnard and will probably be elected mayor as that is the place he made "The Sheik".

Georges Benoit, A. S. C., photographer of Ferdinand Pinney Earl's "Omar Khayyam"; and "The Masquerader" starring Guy Bates Post, has been retained by Richard Walton Tully to photograph "Omar the Tentmaker" also starring Mr. Post. Mr. Benoit is a native of France and one of the cleverest cinematographers that ever made a close-up.

Hymeneal

Mr. Joseph A. Dubray, honored member of the A. S. C., was married Thursday, April 20th, to Miss Grace Turner of Los Angeles, and the happy couple departed at once on a motor honeymoon to the north. Mr. Dubray is one of the best known and highly respected cinematographers in the motion picture industry and as well known in Europe as in America, having been connected with many of the most celebrated producing companies of both countries.

The bride is a native of Tacoma, Washington, and is beloved by a wide circle of friends. She is charming, accomplished and an expert at continuity writing, having been connected with Metro, Hayakawa and other producing companies.

Mr. and Mrs. Dubray will be at home in Hollywood after May 1st. The congratulations of the A. S. C. with wishes for a long and happy life are extended Mr. and Mrs. Dubray.

Buys a Mitchell

George Barnes, A. S. C., with the King Vidor Company, has purchased a new Mitchell camera and is shooting with it. Mr. Barnes gives the Mitchell a whole hearted boost, the strongest part of which is the fact that he bought one.

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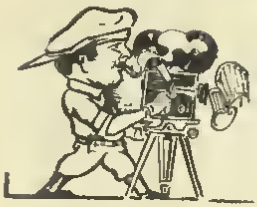
100,000 Pictures Per Minute

By C. Francis Jenkins

(From Transactions of the S.M.P.E.)



The Papers Committee has suggested that an illustrated talk on what has been accomplished this summer to further the development of high speed photography would be interesting to the members of our Society. It was this suggestion which resulted in the preparation of this paper.

The rate of exposure is 1600 frames per second in most of the pictures which will be shown you, that is 400 feet of negative is run through the camera in four seconds of time and 16 pictures per foot impressed thereon. The negative is the regular Eastman stock and is not special in any way; the lenses used are the usual B. & L. f-3.5, mounted in a special tube. In the preferred form of camera for extreme speed there is a plurality of these lenses, and they are used wide open all the time. There is no shutter employed. Of course, the only possible way that 400 feet of film can be passed through a camera in four seconds is continuously—intermittent movement being wholly out of the question.

Those who saw the crude results exhibited at the Bureau of Standards meeting last May will remember that 100,000 pictures per minute was the goal set for the summer's work. Not only has this been accomplished, but results have been attained which are very superior to those then shown, as you will observe from the pictures which will be shown in connection with this paper.

As will readily be suspected, a great many unforseen difficulties arose as we attempted persistently to make motion pictures a hundred times faster than normal, but these have been overcome one by one until now the camera is set up with a rather high degree of confidence in the result, for the point has been reached in the development of this instrument where a nearer approach to perfection will be made by the skill which comes from repeated use rather than by material change in the camera.

Incidentally I might add that two shots were made at twice the speed, that is, 200 feet of film per second, but on taking out the first roll it was found that the heat generated in the film softened the gelatin to such an extent that the convolutions stuck together and the roll of film could not be unrolled. A second shot was made with the edges lightly lubricated, and very creditable pictures resulted. But as the speed seems to be much higher than there is any call for at the present time, no further work along this line was attempted. However, there does not appear to be any reason for hesitation in undertaking the construction of a camera to handle film at the rate of 3500 exposures per second if need for this should be found. I am quite confident that it can be done.

Surprises continually came up in the work, for one is hardly prepared for some of the phenomena which developed; for example in the first attempt to get more pictures per second than I had theretofore made, the heavy spring belt take-up, which had been satisfactory at 50,000 exposures per minute, did not wind up the film at all at 100,000 per minute, for the reason that the belt made a circuit around the pulley it was supposed to drive without touching the pulley at all, centrifugal force holding it entirely clear of the pulley. We put a cord inside the spring belt to kill the force at the end of the tangent and have had no further trouble from that source. At higher rates direct drive and friction plates would doubtless be needed.

Incidentally, new hazards were discovered in attempts to mechanically handle film at 100 feet per second. In first trials some old out-of-date stock was used and the camera door was left open so that the action could be watched. As the last end of the film passed around the sprocket, a piece about 1½ inches long was snapped off and, flying in my direction, cut a severe gash in my bare arm, though I was seventeen feet away. Always there is found in the receiving magazine quite a quantity of bits of film, for the end frays out like the cracker of a whip before the motor can be stopped.

Tension of any kind is out of the question. The best result so far has been attained by guiding the film in a narrow channel made of very dense wood, grainless, and having an oily feel.

Resistance seemed to develop as the cube of the speed. One horse power is required to drive the camera; a ½ horse-power motor will not bring the instrument up to speed. There is but one pair of gears in the camera.

These things are mentioned only to show that very little of past experience in motion picture photography is of much benefit in attempts to handle 100 feet of film per second in a camera.

However, as there are many important problems upon which information can be obtained only by photographic divisions of time at this high rate all this effort seems well worth while, as for example, information about the recoil of a gun, the flight of a shell, the impact of a shell against plate, is considered by the Ordnance Department very much worth while.

For the Navy, photographs were made of a big HS2 plane getting off the water. The forty-mile-an-hour travel of the plane at the getting-off moment, when reproduced at normal speed, appeared as but one-half mile an hour, and the pilot, when he saw it, seemed really distressed about this fact.

I have begun, for myself, the use of this instrument in the study of physical law, not widely known, I believe, but which may be written as follows:

Any object free to move in a fluid will move toward that part of the fluid having the swiftest motion.

This seems to account for phenomena not explained by any other physical law, for example, why strong swimmers are drowned in the ocean undertow, why logs ride the crest of a freshet, why a ball stays up in a stream of air, why plate glass windows break outward, why leaves are lifted off the ground, even heavy boards picked up and carried long distances, why a card can't be blown off the face of a spool by blowing through the hole in the spool, why birds soar in the air without apparent effort, why airplanes are sucked up into the sky. (I believe it is not very generally known that 75 per cent of the lift of an airplane is above the wing, and only 25 per cent underneath), and why flags flutter.

I was never entirely satisfied with the explanation which you will remember is given in "Alice in Wonderland," that it was her "Oldman of the Mountain" who furnished "flutters for flags, rustles for silk dresses, and a very superior quality of post hole."

It seems more logical to remember the law that the body must move toward the swiftest part of the fluid medium in which it rides, and that this force is as increasingly powerful as the difference in the flow in adjacent parts of the fluid stream. My collection of pictures of this phenomena are not complete, and therefore will not be presented at this time.

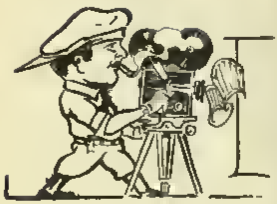
However, while the samples I shall show you are of simpler kind very interesting phenomena is disclosed even in these, and it is believed valuable data may be obtained by high speed photographic time divisions in science and engineering when taken up seriously, though scarcely a beginning has yet been made.

Incidentally, it may be interesting to note that an entirely satisfactory means for counting the exposures at this high speed has not yet been worked out, and I do not at the moment recall any problem in science or the arts that has required the development of a timing device dividing the second into a thousand or more parts, which is suitable for this work. I would appreciate suggestions.

Analysis of Motion

By C. P. Watson

From a paper read before the S.M.P.E. Reprinted by special permission.



Owing to certain tests made in steel foundry production early in 1917 and the inability to obtain more than a momentary viewing of such tests through the medium of standard motion pictures, my thoughts turned to the subject as to how a better understanding of problems confronting us could be obtained, which led to some haphazard, spasmodic experiments along the lines of "slowing down" motion picture photography. During the year 1917 I devoted almost constant study to the subject, and manufactured a crude model of a "Novagraph" camera, in fact, many crude models. I am quite sure were I afforded an opportunity to put a yard-stick on the raw stock used in my experimental work during that single year the gross footage would reach around the world.

In 1918 I was fortunate in perfecting a "Novagraph" camera capable of producing approximately 125 to 160 pictures per second, which went far to the realization of what I had hoped for.

In the latter part of 1918 and early in 1919 I so far perfected high-speed photography that the product of the cameras then available proved acceptable to the film distributors and met with hearty approval of the theatre-going public.

When "Analysis of Motion" first appeared on the screens of motion picture theatres they caused considerable amusement and very little serious interest on the part of the spectators. They were impressed with the sight of ball players athletes, swimmers, divers, horses racing and hurdling and innumerable other subjects, but utterly failed to appreciate the goal which it was my ambition to reach and in which I foresaw the tremendous, inestimable value of "Analysis-of-Motion" motion pictures.

My ambition had been to prove to the scientific and professional world the value of "Analysis-of-Motion," and I may say the "Novagraph" cameras are now being used many times more active in the domain of mechanical and medical science than in the field of pure amusement.

It is not necessary to explain here the great difference between standard motion picture photography and "'Analysis-of-Motion," photography. All motion picture people know that if film is exposed to the subject at the rate of four a second and projected at normal speed, action that consumed four seconds in actuality is shown on the screen in one, and the result is the exaggerated speed often used in comedies. Pictures taken at the rate of thirty-two a second and projected at normal speed would show in two seconds something that actually took place in one. The new and greatly improved "Novagraph" cameras expose film to the subject a minimum of 480 times per second, and the projection of the positive print at normal speed permits a thirty-second study of an action actually completed in one second.

In analyzing the flight of a 12-inch projectile, weighing 1500 lbs., with a veocity of 2007 feet per second, it was possible to obtain a perfect picture of the projectile as it approached and came in contact with a 12-inch thick armor-plate target, case hardened throughout, through which was proven the projectile did not penetrate the target at the point of impact, as a decided skid was shown prior to penetration. The target was set at an angle of twenty-five degrees from the gun. Unfortunately at the instant of penetration flying splinters destroyed the lens and demolished the front of the camera.

Within the past three weeks an "Analysis of Motion" picture of an automobile was made covering 100 feet of measured roadway. The automobile covered the distance in three seconds flat and 1208 perfect pictures in 75 feet of film were proven.

1. Four hundred perfect pictures per second were secured.

2. The film exposure was 25-feet per second, an average of 400-feet in 16 seconds.

3. One perfect picture for every inch of the 100 feet covered by the automobile was secured.

In this test the "Novagraph" camera used was by no means driven to its maximum speed. It can readily be operated at double that speed with a possible resulting twice as many pictures per second.

I am proud to say that I have had the privilege of making "Analysis-of-Motion" motion pictures of many medical subjects, particularly of persons afflicted with nervous disorders resulting in constant and uncontrollable twitching, jumping and thrashing about with arms, legs and body, together with heart analysis pictures, which have won highest commendation both in this country and abroad.

In one instance, as one of ten subjects, I made a series of "Analysis-of-Motion" motion pictures of a young woman, who at the age of seventeen years, lay for many days at the point of death as the result of fright sustained during the course of a particularly severe electric storm. Within two months thereafter symptoms of hysteria developed and continued until at the age of twenty, three years after the occurrence, she became practically helpless, unable to stand alone, her entire body was in constant motion and he case pronounced incurable. At this point my work started in the hospital in which she was an inmate.

At a gathering of prominent physicians of New York and other cities the projection of the "Analysis-of-Motion" pictures of this particular young woman upon the screen disclosed an hitherto unsuspected muscular agitation in her left leg, which resembled nothing more closely than the quiver of jelly which had been well jellied. This particular muscle tremor extended from below the left knee-cap to the hip apparently a continuous motion traveling from the knee-cap to hip and returning to its starting point, aroused intense interest in the minds of the physicians, from among whom a committee of three was appointed to examine the subject, with a resulting report they were unable to detect the muscular tremor with the naked eye and that the standard motion-picture film utterly failed to disclose it.

Less than a month ago I was informed by a professor of neurology in one of our leading colleges, conversant with the case, that the study of this hitherto unsuspected condition had led to a different course of treatment in connection with nerves leading to the brain, that the young woman had materially improved and it was now safe to say she would ultimately recover.

This muscular movement has been described by the medical profession as a "muscle-wave" for the want of a better name.

We should all be proud that motion pictures have risen to greater heights than purely amusement features. They have pointed out a new method of medical treatment which may alleviate the sufferings of humanity and prolong life.

Motion Picture Nomenclature

Society of Motion Picture Engineers

Definitions adopted by the Society of Motion Picture Engineers, at its Buffalo, N. Y., meeting, October 31, and Nov. 1st, 2nd and 3rd, 1921

ACTION—The director's signal to the players to begin performing.
ARC—A column of very hot light-emitting gas, carrying an electric current sustaining this condition.
BACK FOCUS—The distance from the principal focus of a lens to its nearest face.
BUSINESS—Action by the player; e. g., business of shutting door.
CAMERA—The director's signal to the photographer to begin taking the scene.
CHANGE-OVER—In projection, the act of changing from one projector to another without interrupting the continuity of projection.
CINE—A prefix used in description of the motion picture art or apparatus.
CLOSE-UP—Scene or action taken with the character close to the camera.
CONDENSER—The lens combination which deflects the diverging rays of the luminant into the projection lens.
Collecting Lens—The lens of the condenser nearest the light source.
Conveying Lens—The lens nearest the objective.
Center Lens—The lens of a three lens combination, lying between the collecting lens and the converging lens.
CUTTING—Editing a picture by the elimination of unacceptable film.
CUT-BACK—Scenes which are returns to previous action.
CUT-IN—Anything inserted in a scene which breaks its continuity.
DEVELOPING—Making visible the latent image in an exposed film.
DISSOLVE—The gradual transition of one scene into another.
DIRECTOR—The person who superintends the actual production of the motion picture.
DOUBLE EXPOSURE—The exposure of a negative film in a camera twice before development.
DOUBLE PRINTING—The exposure of a sensitive film under two negatives prior to development.
DOUSER—The manually operated door in the projecting machine which intercepts the light before it reaches the film.
DUPE—A negative made from a positive.
EFFECTIVE APERTURE—The largest diameter of a lens available under the conditions considered.

Definitions submitted by the Nomenclature Committee for consideration by the Socity of Motion Picture Engineers:

EQUIVALENT FOCAL LENGTH—The equivalent focal length of a combination of lenses is equal to the focal length of a simple thin lens which will give an image of a distant object of the same size as does the combination lenses.
FILM SIZE—See Special Report of Committee.
FRAMING—Moving a frame into register with the aperture during the period of rest.
LANTERN PICTURE—A still picture projected on the screen by a stereopticon.
LANTERN SLIDE (Stereo Slide)—A transparent picture for projection by a stereopticon.
PROJECTOR—A lantern for suitably moving and projecting motion picture film.
RETAKE—A second photograph of a scene.
SPLIT REEL—A reel of film of two (or more) parts, the subject of each part unrelated to the subject of the other part.
EXTERIOR—A scene supposed to be taken out of doors.
FADE-IN—The gradual appearance of the picture from darkness to full screen brilliancy.
FADE-OUT—The gradual disappearance of the screen-picture into blackness. (The reverse of fade-in.)
FEATURE—A pictured story a plurality of reels in length.
FILM—The ribbon upon which the series of related picture elements is recorded.
FIXING—Making permanent the developed image in a film.
FLAT—A section of painted canvas, light board, or the like, used in building sets.
FLASH—A short scene, usually not more than three to five feet of film.
FLASH-BACK—A very short cut-back.
FOCAL LENGTH—The distance from the center of a simple thin lens to the image formed by it of a distant object.
FOOTAGE—Film length measured in feet.
FRAME—A single picture of the series on a motion picture film.
FRAME LINE—The dividing line between two frames.
INTERMITTENT SPROCKET—The sprocket which engages the film to give it intermittent movement at the picture aperture.
IRIS—An adjustable lens diaphragm.
IRISING—Gradually narrowing the field of vision by a mechanical device on the camera.
INSERT—Any photographic subject, without action, in the film.
INTERIOR—Any scene supposed to be taken inside a building.
JOINING—Splicing a continuous strip (usually 1,000 feet) the separate scenes, titles, etc., of a picture.

Billy Foster Retires

Smiling Billy Foster, watch dog of the treasury of the A. S. C., during the year 1921, has turned over the strong box to Jackson Rosa, his successor, and will let Jack do the worrying for a year.

Mr. Foster is a charter member of the A. S. C. and one of the most popular and successful cameramen in the industry. His long career has been high lighted by many cinematic triumphs and he is hailed by his fellows as a master of his profession. Billy Foster began camera work in 1901 but he's only a young man now.

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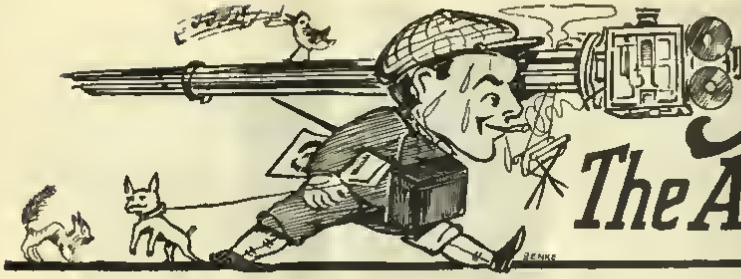

Jimmy The Assistant

KIN you remember, way back in them good old days, when you could get the biggest one in town for a nickel at almost any corner, (with free lunch, too! remember them boneless herring what used to think your tonsils was a pin cnshun, and the big salt on the good two-for a nickel cigar for only five cents, instead of fifteen, like it is now? And when a guy that owned a auto, as they was called, was thought some considerable guy?

If you kin, then mebbe you remember that funny little place called the "Odeon," or "Bijou," or "Optic," or sump'n like that, where you paid a nickel to go in and see the moving pictures.... what kind didn't matter.... you was always pretty sure they would be about cowboys and a villun who gets hung in the end, or a lot of Frenchmen chasing a runaway baby carridge which has tipped over a apple cart . It didn't make no difference; it was a interesting nickel's worth, and as we all has more or less spendthrift in us, what's a nickel anyway?

And how they used to have a phonograph with a big horn outside which played all the latest hits on sylinder records like "In the Shade of the Old Apple Tree," and "Pony Boy" and all them! And inside they had sombody to play a pianna which had saw considerable better days, and how this fellow used to whang away at whatever he had started no matter what was showing, except to play it fast near the end where the chases always was. And illestrated songs, with hand colored....probly the guy had palsy....slides, which showed what they was'nt singing about, and the slide they always used to show, reading, "'One minute pisase, to change reels'" And it was only a nickel.

Them days has went Now we has the best for movie places Darn few regerlar stage places has anything that is near as good as our big movie shows. The reackshun from the little old nicklodeon show was sump'n awful when it hit. We hae seen funny orkestras which plays bangety bang things while part of the oudience walls there eyes and tries to look bigh-brow, while the rest is hored, becauses these here orkestra leaders is hum sports..won't take a chance....won't play nothing 'cept things evrybody knows, and is supposed to like, such as the "Sextette" Bet I've heard that thing 491 times at movie conserts And we have vadyville, and travel pictures, and cartoons, and jokes, and soft seats, nd thick rugs in the lohby where there used to be oilcloth in the old days, if it was a swell joint, and unyformed ushers, and all the dog in creashun. But it costs anywhere from four bits to a huck!

Here the public seems to have somewhere got the yen into there heads that the differense in enjoyment aint worth the difference in price, and that idear aint only just nearly wrecked the movie game with this here slump which we has all kinda noticed, but it has started a new reackshun in the general direcshun of the old nickle show. When the movies husted ont into high society with its gold lobbys and perzian wrugs, &, etc, and so forth, it overdone it Them things all cost dough, which the public has to pay and they aint enough of em willing to pay for the loddy-da stuff to make it go, 'cept, of course, during our war time spending bee. The public wants movies for there money, not fancy furnichure; they can see all that they want for nothing in furnichure store windows. They wants movies, and they getting it, and that brings us to the reackshun on the part of the movie audiences—our bosses, if you please—they is the ones which ackchually pays us—to the reeznable priced, picture showing neighborhood theater!

The community picture show is the biggest thing on the movie horyzon It s like the corner grocery store, handy. No long, crowded car ride, to and from town with the famiiy. Like as not you know the guy who runs it—mebbe he's your neighbor—and you aint afraid to put in a kick if you don't like the show The privilidge to complain is one of the best things about friendship Anyway, them complaints is a big help to better pictures, and they most all comes from neighborhood theaters

The show is just egzactly the same as when it run at a hard to get at, expentsive place down town, as far as movies is concerned, except it is shown here two weeks later. Darn few pictures perduced nowdays are so important you can't wait that long to see

Some brilliant egg invented a organ that plays itself a lot better than a bored organist does by hand, so you get good enough music for anybody to see a picture by. The place is comfortable, good seats, a pretty interior, modeled after the bigger dumps, and well enough lighted so you can't see nothing when you come in, and too much after your there a while But they cant help that!

The biggest thing in the picture game today is the neighborhood theater. And it only costs a quarter!

Jack Rose, Treasurer

Jackson Rose is the new watch dog of the treasury of the A. S. C, having been unanimously elected at the annual meeting, April 11th, 1922.

Mr Rose needs no introduction. He is one of the veterans of the industry, having nineteen years experience in all branches of photography to back him up

He broke into motion pictures away back in the early days of Essanay and has been steadily in the harness ever since Jack is the man who shot the first Bell & Howell camera (Old No. 1) on the Essanay lot away back in 1911.

Motion Picture Nomenclature

(Continued from Page 25.)

LEADER—That piece of blank film attached to the beginning of the picture series.

LENS, SIMPLE—A lens consisting of but a single piece of glass or other transparent medium

LENS, COMPOUND—The combination of a number of simple lenses.

LIGHT BEAM—A bundle of light rays which has a cross section of appreciable size.

LIGHT RAY—A stream of light of inappreciable cross section

LOCATION—A place other than a studio selected for a motion picture scene

MAGAZINE VALVE—The film opening in the magazine of a motion picture projector.

MASKS—Obaque plates of various sizes and shapes used in the camera to protect parts of the negative from exposure

MOTION PICTURE—The representation of an object by the rapid presentation to the eye of a series of pictures showing the object at successive intervals of time

MULTIPLE-REEL—A photoplay of more than a thousand feet of film in length

NEGATIVE—The developed film, after being exposed in a camera

NEGATIVE STOCK—Light sensitive film inteded for motion picture camera use

OBJECTIVE—The simple or compound lens nearest an object which forms an image of it

OPAQUE PROJECTOH (often called "Post card projector")—Lantern for optically projecting opaque objects, picture post cords, or the like

OPTICAL AXIS—The straight line through the centers of the light source lenses, diaphragm, etc., of an optical system, to which their planes are in general perpendicular.

PANORAM—To rotate a motion picture camera about an axis perpendicular to the tripod top

PHOTOPLAY—A story in motion pictures

POSITIVE—The developed film, after being printed from a negative.

POSITIVE STOCK—The light-sensitive film intended to be printed upon through a negative.

PRE-RELEASE—A picture not yet released for general public showing

PRINT—Same as "positive."

PRODUCER—The maker of motion pictures

PROJECTION DISTANCE—The distance between the projection lens and the surface upon which the image is focused

PROJECTION LENS—The objective which forms upon the screen an image of the lantern slide, film or other object under examination

REEL—The flanged spool upon which film is wound.

REEL—An arbitrary unit of linear measure for film— approximately a thousand feet

REGISTER—To superimpose exactly

REGISTER—Any indication produced by simulation

RELEASE—The publication of a moving picture

REWIND—The process of reversing the winding of a film, usually so that the end to be first projected shall lie on the outside of the roll

REWINDER—The mechanism by which rewinding is accomplished

SCENE—The action taken at a single camera setting.

SCENARIO—A general description of the action of a proposed motion picture

SCREEN—The surface upon which a picture is optically projected

SHUTTER—A moving element, usually a disc, which intercepts the light in a motion picture apparatus one or more times for each frame

Shutter—Working blade—(also variously known as the cutting blade, obscuring blade, main blade, master blade or travel blade) That sector which intercepts the light during the movement of the film at the picture aperture

Shutter—Intercepting blade—(also known as the flicker blade) That sector which intercepts the light one or more times while the film is stationary

SINGLE PICTURE CRANK (sometimes referred to as trick spindle)—A crank on a motion picture camera which makes one exposure at each complete revolution

SLIDE (Stereo slide)—See "Lantern Slide."

SPLICING—Joining the ends of film by cementing

SPOT—The illuminated area on the aperture plate of motion picture apparatus

SPROCKET—The toothed cylinder which engages the perforations in the film

(To be continued.)

Spring Meeting of the S. M. P. E.

Following is a partial list of papers to be read at the Spring Meeting of the S. M. P. E., Hotel Bellevue, Boston, May 1st, 2nd, 3rd and 4th, 1922:

Trick Photography,
Mr Alfred B. Hitchins, Ansco Company.

Constant Potential Generators for Motion Picture Projection Service,
Mr A. M. Candy, Westinghouse Company.

Preservation of Motion Picture Negatives,
Mr. George Blair, Eastman Kodak Company.

Graininess in Motion Picture Negatives and Positives.
Mr A C Hardy and Mr. L. A. Jones, Eastman Kodak Company.

Some Uses of Aspherical Lenses in Motion Picture Projection.
Dr. Harman Kellner, Bausch & Lomb Optical Co.

A Negative Test Method for Condenser Design.
Mr. J. T. Beachland, General Electric Co. (West Lynn.)

The Film Splicing Machine
Mr. J. H. McNabb, Bell and Howell.

Visual Education.
Mr Rowland Rogers, Picture Service Corporation.

Spirograph and Kinekrom Machines,
Mr. Charles Urban, Urban Motion Picture Industries.

The Motion Picture of the Future and the Imaginary Equipment,
Mr. S. L. Rothafel, Capitol Theater.

Color Photography.
Dr. C. E. K. Mees, Eastman Kodak Company.

(Subject not submitted.)
Mr. Alvin Wyckoff, Famous Players-Lasky.

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A Standard Density in the Printing of Motion Picture Films

A Paper Read at the Allied Film Laboratories Association Banquet, February 1, 1922

Allied Film Laboratories Association.

Gentlemen: I think I would better confess at the outset that my motives in coming here to-night are purely selfish. The Society of Motion Picture Engineers has directed its Committee on Standards to report upon the desirability and feasibility of a standard density in the printing of motion picture film. Accordingly, when I was given this opportunity of meetinng the members of the Association of Allied Film Laboratories, I at once welcomed the occasion as offering means of collecting the opinions of that group of men most familiar with and most interested in this particular phase of the motion picture process. I come then, not as one bringing information, but as one seeking knowledge, a collector and tabulator of ideas, not an originator of them and if some of the things I may say seem to show an opinion already formed, I assure you, gentlemen, that the formation is so recent and of such an unfinished nature as to be easily subject to revision.

There are many kinds of units. The fundamental units of length, mass and time are of such vital importance in all human relations that the governments of all civilized countries of the world have taken the matter of standardizing these quantities into their own hands. It is, of course, much to be regretted that all countries have not the same standards. This is a condition that everyone now wishes had long ago been corrected. Unfortunately however, the more the need arises for a uniform standard and system of measuring, the more machinery has been made according to the old standards and the greater the loss entailed in a change. Accordingly, we in this country waste yearly a tremendous amount of time in calculations with our cumbersome system of weights and measures, for lack of the courage to accept a larger loss once and for all. Everyone wishes to pass this loss along one more generation. So the evil continues.

There are a great many units which are, by definition, determined when these three fundamentals are once fixed, such, for example, as the units of volume, velocity, and inertia. Each branch of science has built up a still more complicated system of units more or less convenient, in which it measures those quantities specially belonging to it. Some of these units are chosen arbitrarily and the others in turn derived from these as, for example, the unit magnetic pole is defined in terms of electric current and length. The actual size of these "special" units, if I may so designate them, is determined by common agreement among those most interested in their use. There was no theoretical necessity for the adoption of the resistance of a meter of mercury one millimeter in cross-section, at a given temperature and pressure, as the value of an ohm. A silver bar of the same size might have been chosen and would have served as well on theoretical grounds—or the mercury column could have been twice as long or had twice the area. It was simply that the British Association decided arbitrarily on this particular standard, and so good did this seem to the electrical world, and so great was the prestige of the British Association, that this mercury column became the standard ohm.

In this same way engineering bodies have chosen certain arbitrary units in terms of which their measurements are made. Each of these units must have a standard with which it can be directly compared, or its numerical value must be given in terms of some other standard of this branch of engineering, or of some standard already well established. Examples of such arbitrarily chosen standards can be found in every branch of engineering. We need mention but one as illustration—the standard gauge in use among railroads. I think I am right in saying that the majority of those best able to judge now think it would be better if this standard were larger, but again, so great a loss would the change involve that it seems at present out of the question. This illustrates the need of the greatest care and foresight in the establishing of engineering standards.

The establishment of such standards is one of the prime reasons for the existence of engineering bodies, and, I might add, one of their greatest sources of dissension. The bitter controversies waged about those dimensions fixed long ago, have been forgotten in the convenience and harmony that a satisfactory universal standard invariably brings. So we now, in our effort to standardize, should not be too much influenced by the objections of a small minority. At the same time, we must never lose sight of the incalculable injury that would be caused by the selection of a standard dimension that is now, or will soon become, unsatisfactory.

The motion picture industry has perhaps the least excuse of any branch of applied science for not obtaining and using satisfactory standards. There is no other engineering line in which the same elaborate and accurately cut product passes through as many different and independent processes as does the motion picture film, and often no two of these processes are controlled by the same concern. Not only is the film manufactured by one company, taken by another, developed and printed by a third and used by a fourth, but the theatres can use any one film but a short time to advantage. Accordingly, a circulating system is essential. This, again, is the strongest of reasons for having the film interchangeable. It is to be regretted that the dimensions adopted in America do not agree exactly with those of the English as adopted by the Incorporated Association of Kinematograph Manufacturers, tho both standards can be run on the same machine.

At present, then, there is thorough co-operation between the various branches of the industry with respect to the size of the film used. There are two other factors, however, that, if not as necessary of standardization, should not be left out of consideration entirely. These two things are average density of negative, and contrast and it is the investigation of these two properties of the film in which we are at present particularly interested.

I believe it is now the universal custom to make a number of prints of different densities from each negative film, and from the examination of these to choose the time of exposure of the final print. To one unfamiliar with the technique of printing, this method would seem to have objections. It is obviously impossible that the judging be carried on under the same conditions as those under which the film will be used, since theatres differ so much in the screen and auditorium illumination, in the size and distance of the picture and in many other ways that will affect the appearance of the screen. Apart from any difference of opinion among the judges, an allowance must be made for the different conditions obtaining in the final projection. I have it on good authority that sometimes eight times the intensity of illumination is used for judging as is found on the average theatre screen. I know that many prints are judged by holding them up to the sky or in front of a screen illuminated by daylight. Such surroundings and illumination will change so much during a few hours, or even minutes, as to cause serious doubt as to the reproducibility of results obtained by such methods. In any event it would seem quite impossible to make sufficient allowance for such "abnormal" methods of viewing a film.

The only obviously accurate way of determining that density of film that "looks" the best is to decide, first of all, upon some specified value of the various factors that go to determine the appearance of a picture in a theatre.

The average values of these factors as found at present might be selected as standard, or some arbitrary values might be chosen, with the expectation of the theatres gradually conforming to these standards or making allowance for the departure they find necessary. Prints selected under these conditions would represent, apart from individual judgment, the proper printing of the negative in question for a theatre complying with the standards selected.

There are, of course, great objections to this method of judging films. Apart from the trouble and time required, a theatre is necessary. Again, the length of film that must be printed to each density for trial is considerably greater than at present, and perhaps the difficulty of comparing different trials, run successively as they would probably be, might be great.

These are doubtless some of the difficulties that have prevented the adoption of standards in printing. And to balance all this trouble and expense, what is the gain—an added ease in the determination of the amperage necessary for projection, with a little lower allowance for the over-dense film, slightly more assurance against the flaring out of the thin film, a little more uniformity successful picture. Whether the possible gain in picture quality will justify the inevitable increase in expense is just the sort of thing that this society of yours, gentlemen, is called upon to determine.

If you will allow me, I shall read a part of a paper presented before the last meeting of the Society of Motion Picture Engineers on the printing of film.

The one absolute essential for a print is that detail necessary for the understanding of the picture must be present on the screen. Obviously this detail cannot appear on the screen unless corresponding detail exists in the positive film.

Now detail exists in a picture only through contrast, and, in the case of monochromes, through density contrast. It is true that detail depends also on contrast gradient, that is, on the width of the strip through which one density fades into another, as well as upon the difference in the two densities. The width of this strip depends, however, on the sharpness of the negative. With this the present discussion has nothing to do—it deals simply with the printing of a given negative.

The first step in the solution of the problem is, then, to have sufficient contrast in the necessary parts of the picture. By "necessary" is meant those parts necessary for the understanding of the picture.

Whether or not the contrast will be sufficient, will depend, apart from the contrast o fthe negative, on the slope of the characteristic curve of the positive film. Since this slope is a maximum at one point and but slightly less than this thru a considerable range, (1) (The so-called "region of correct exposure"), falling off then more rapidly to zero for exposures below and above this region, the positive must for maximum contrast be printed such a length of time that every part of interest has an ex-

posure in or near this region. If there is sufficient contrast in a particular area of the negative, the time of printing may depart considerably from that of the region of correct exposure for this area. If there is but slight constrast, then any under- or over-exposure may lessen the contrast beyond the limit of eye sensitivity. If the contrast in the negative is too low, satisfactory detail will be impossible for any exposure, unless in some way the slope of the characteristic curve can be increased. Knowing the characteristic curve of the positive film the latitude of exposure for the necessary contrast of each part of the film can then be determined, and those exposures which all parts have in common, represent the latitude of the whole picture.

That the time of exposure shall lie within these limits is a necessity, but for the great majority of films there is a wide range of exposure that satisfies this condition. Are there any other conditions it is desirable to fulfill?

So far the physical or objective contrast alone of the screen picture has been considered. The subjective or apparent contrast is naturally that of most interest. This depends not only upon the physical contrast but also upon the actual quantity of illumination. If this illumination is of too low a value, the physical contrast would not seem as great as it would if more light entered the eye. (2) In other words, unless there is sufficient light on the screen, full benefit of the physical contrast will not be obtained. Accordingly, since the light on the screen is proportional to the transmission factor of the film, if the source and the optical system are not such as to put sufficient light on the screen through a film printed to maximum contrast, then a decrease in density will perhaps give a greater apparent contrast, though a smaller physical one. Too too much light decreases the apparent contrast also, this condition is so rare in motion picture projection as to be of little interest.

Eye-strain would probably be reduced to a minimum if the eyes were required to change their adaptation level as little as possible. The eye-strain is often quite noticeable when a change is made from a dark title to a light picture, such as a cartoon, and becomes really painful when in the midst of a dark scene, the film breaks. The continual adjustment of eye sensitivity necessary with films as printed at present, would be done away with if every film had the same average transmission. Titles at present transmit far less light than the majority of scenes. They are printed dark to give great contrast between the white letters and the black ground. It is a question as to whether the ease of reading thus obtained is not more than neutralized by the effort to adjust the eyes for the change in illumination. The illusion of darkness and blinding light are desirable at times to obtain "effects," and the sudden transition to a lower or higher level of illumination could probably be made far more marked if all scenes in which it was not desired to call attention to the change in illumination, were printed the same average density.

Still another thing that should be considered in timing the exposure of positive film is that the projection apparatus of theatres is supposedly arranged to give satisfactory illumination with the average run of film as now printed. Any wide departure of future standard densities from the present average film density may involve a hardship to some theatres, though probably only to those having at present a low screen illumination.

These considerations would make it seem advisable to have some universal means of determining the time of exposing positive film that would enable each laboratory to expose its film according to some definite rule of density. If then all laboratories adopted the same rule and the same numerical values, each theatre could arrange its projection and general illumination to get the maximum clearness and minimum eye-strain for all pictures, thus contributing materially to the comfort of its audience.

To find out, if possible, about what such a rule for printing might be, twenty strips of positive prints from as many different negatives were obtained from a prominent motion picture laboratory. Each strip consisted of a number of sections, each section having a different time of exposure. The section having what was regarded by the expert judge as the "correct" exposure, was marked with a notch in the side of the film. The light passing thru these different prints was then measured by allowing the light from a constant source to shine thru the film into a photo-electric cell. The galvanometer deflections, very closely

No	Subject	Proposition Clear film	Too Light	Deflection By whole frame Correct	Too Dark	Deflection by 1-16" circle Too Light LP	DP / LPxDP	Correct LP	DP / LPxDP	Too Dark BP	DP / LPxDP
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
—	No film	—	—	175.					7.0					
	Clear film	1.							5.40					
2	Figure	-7	106	85	83	4.15	.45	1.37	3.85	.35	1.15	3 25	25	.90
4	Boat	8	121	80	44	2.85	35	1	1 85	.30	.74	1.55	26	62
1	Figure	5	100	71	43	3.25	1 25	2.02	2.45	1.0	1 57	1.7	75	1.13
13	Auto	-3	83	58	47									
6	Figure	2	90	54	21	3.1	.75	1.52	2 5	.60	1.22	1 55	45	.83
3	"	2	83	53	22	2.8	.85	1 54	2 05	.75	1.24	1 45	45	81
7	"	-2	63	41	26	3.85	25	98	3 25	20	81	2 65	10	51
15	"	0	76	40	13	3.3	.16	.75	3.15	.12	.61	2 45	10	49
9	"	1	67	38	22	4 45	.15	.31	3.85	10	62	3 35	08	52
11	"	4	52	35	22	5.35	.20	1.03	5.0	.15	86	4 75	10	69
18	"	01	33	25	19									
13	"	05	71	25	17	3.05	.65	1 40	2 2	.35	88	1 55	.25	.62
16	"	2	60	24	17	5.0	15	86	4 3	10	66	3 35	05	.41
12	"	1	63.	24.	10	3 45	.25	.93	3.0	.15	67	2 0	12	.49
5	"	0	58	22	13	3.1	45	97	1.55	.35	.78	1.15	.25	54
8	"	-1	43.	20	14									
10	"	.1	48	20	14.	96	45	65	45	.35	39	35	16	23
20	Title		23.	19	16.									
17	Figure	0	26	18	12	2 05	25	.72	1 95	20	62	95	15	.38
14	Title		20	18	13.	3 85	25	98	2 85	15	85	2 05	05	.32

proportional to the illumination are given in the table. It should be noted, however, that the sensitivity of the cell was lowered for columns IV, V, and VI, in order to read the deflections on the scale.

The films are arranged in the order of total light transmitted for correct exposure, as shown in column V. The measurements of each correctly exposed section are given in columns V, X, XI and XII. A frame differing from this in exposure by two steps lighter was also measured and noted in columns IV, VII, VIII and IX, and by two steps darker in columns VI, VIII, XIV and XV.

Columns VII X and XIII give the readings when a 1-16" opening in a mask was put over the highest light in which detail was desirable, columns VIII XI and XIV, when over the darkest shadow requiring detail, and columns IX, XII and XV the square of the product of the two columns immediately preceding each. The geometric rather than the arithmetric mean might be chosen to represent the average light through the film since contrasts are judged largely by differences of illumination relative to total illumination rather than by absolute differences. The logarithms of the values in columns IX, XII and XV are then inversely proportional to the arithmetric mean of the densities.

An examination of the table has so far failed to show any method of selection or comparison by which the light transmitted by the different films gives an indication as to the proper time of exposure. Columns IV, V and VI overlap to such an extent that the exposure can not apparently be judged from the total quantity of illumination passing through a frame. Columns VII, X and XIII, and columns VIII, XI and XIV show that there is a great variation in the light passing through the lightest and darkest points of interest. Nor does either the geometric mean of the light (columns IX, XII and XV) or the arithmetric mean (not calculated throughout), show any regularity from which time of printing could be foretold. The subjects give no indication, except that the two consisting of titles allow but little light to pass.

The assumption throughout these tests has been that the so-called "correct" exposure was, in reality, the most desirable, tho it is evident from the readings that some, if not all, of those qualities mentioned above as theoretically advantageous, are lacking. Certain it is that, by the present method of judging film density, but little account has been taken of the fact that scenes are never run singly, but are links of a long chain, and it is the result of the whole series of prints by which the performance is to be judged—not by the excellence of any single part. The brightness of a picture for best effect, depends largely upon the adaptation level of the eye when the picture is presented if the scene is of short duration, as so many now are. For long scenes the eye will adjust itself to any level within wide limits. It is, then, impossible to know how bright a picture will appear unless we know, among other things, how bright was the picture that immediately preceded it on the screen. This brings us to the conclusion that all the present tests, which take account of nothing but the individual film, if not entirely meaningless for short scenes, at least leave out of account one of the most important factors that go to make a proper film density.

All of this, gentlemen, sounds most unorthodox, but these are the questions that are coming into men's minds more and more as the motion picture industry grows, for no business can reach the colossal proportions of the motion picture business and can be kept so constantly before the public, without attracting minds of every kind to it and its problems. You may say "things cannot be improved enough

to pay for the cost of improvement" but this statement will not stand without proof Real evidence of an experimental nature must be brought forward to show whether improvement can or cannot be made, and, gentlemen, this Society the Society of Motion Picture Engineers, and similar organizations will be held accountable by the public for this evidence It is one of our reasons for being, and we cannot justify our existence without making a determined effort to get satisfactory answers to these questions, whether this effort leads to immediate improvement or whether it shows that improvement along these lines must be delayed

In closing, I wish to say again how very much I have enjoyed meeting you, gentlemen how much I have enjoyed talking to you as a representative of the Society of Motion Picture Engineers, and what enthusiastic co-operation I can assure you you will have from that Society in anything you may undertake toward the standardization of motion picture films

FOOTNOTES

(1) "The Photographic Rendering of Tone Value," Jones, Jour Franklin Inst April, 1920.

(2) "The Fundamental Principles of Good Lighting," Nutting, Jour Franklin Inst 183, p 287, 1917.

A Rothacker Anniversary

Workers in the Rothacker Chicago studio-laboratory will give a party to themselves the first week in May, on the anniversary of the founding of the Rothacker Film Mfg Co Twelve candles will glitter in the birthday cake to be cut at the studio

In May, 1910, Watterson R Rothacker rented desk room in a small Chicago office, and became the pioneer practical picture producer, being the first man to make a serious attempt to adapt the pulling power of the silver sheet to the uses of business.

That was before the days of the feature films Motion pictures were still considered a novelty by many Conservative business men gazed with surprised interest upon the earnest young man who walked into their offices and asked them to enlist a regiment or so of their real dollars in the cause of advertising and selling movies

That year the trail blazer made a tour of advertising clubs and chambers of commerce in the role of film advertising evangelist "I received lots of encouragement, but few orders," reminisces Mr Rothacker

But the time came when he could behold his "organization"—one stenographer—on pay day and still smile And when he was firmly established as a practical picture producer he began engaging in film laboratory work on a small scale.

Then in 1916 the present studio-laboratory was opened on Diversey Parkway, Chicago Last year he and Joe Aller became team-mates in the Rothacker-Aller laboratory of Hollywood

"My faith in the motion picture industry is at least twelve times stronger than it was in 1910," said Mr Rothacker recently, and he is now preparing to back his faith with three more laboratories He has a representative at present in Canada paving the way for a Toronto plant In June he sails for Europe in connection with the laboratory he is going to build in London New York will be the fifth link in the laboratory chain

Incidentally, the president of the company will begin his thirty-seventh lap on Dad Time's saucer the same week as the firm's anniversary—on May 6. Mr Rothacker has always been active in the industry. He was vice president of the first Motion Picture Board of Trade and for several years was chairman of the N A M P I. membership committee. During the war he created the "Mile of Smiles" for the A E F He also wrote the first book on film advertising and at present is on the faculty of the Page-Davis School of Advertising. He represents the industry on the Advertising Council of the Chicago Association of Commerce.

New Mitchell Catalogue

The Mitchell Camera Company have just issued a handsome catalogue compiled and arranged under the supervision of Mr Lyman Broening, A. S. C., setting forth the fine points and superior construction of the Mitchell. Quoting from the introduction:

"While the ideal and principles of the Mitchell Motion Picture Camera are new to the industry, their original introduction to practical use dates back some years

"In 1914 Mr J. E Leonard, creator of the original camera of this type, began the construction of several cameras, embodying the features generally employed and now greatly improved. Mr. Leonard having been thoroughly experienced, as a practical motion-picture photographer, knew the needs of the camera operator and the necessary attributes of a really practical cinematographic camera. Two of Mr Leonard's original experimental cameras are still in use.

"Later on, after considerable improvement and development the rights to the Leonard Camera were acquired by the Mitchell Camera Company. Under the expert direction of Mr George A Mitchell, it has gone through the process of re-designing and brought up to its present state of perfection. Many of the early ideas have been retained. The intermittent movement, however, is of entirely new design and is the height of mechanical perfection.

"The Mitchell Motion Picture Camera has combined the practical requirements of the camera operator with precise mechanical construction The result has been an instrument, designed and built to meet the requirements and up-to-the-minute demands of those engaged in the production of motion pictures.

"The operation of the Mitchell Camera is simple, quick and positive. It appeals to the producer by reason of its time and film saving features It appeals to the operator by reason of its exclusive mechanical features It appeals to both by reason of its absolute dependability."

Visual Education in Los Angeles Schools

VISUAL EDUCATION, especially that branch involving the use of motion pictures, has made very substantial progress in forcing itself to be recognized by the educators of the country as a necessary adjunct in their work.

Realizing the wonderful possibilities in presenting subjects to the students through this modern teacher, the city of Los Angeles has again shown itself the most progressive city by instituting a very efficient department of visual instruction. At this time Los Angeles can boast of approximately sixty motion picture machines in the schools, forty-five of which are De Vry projectors, a portable machine.

The school board itself owns considerable film, most of which is technically educational and was produced specially for school use This is circulated through the schools under the supervision of the Public Schools Library which has a competent force who outline the use of the film to fit in with the regular course of study Motion pictures do not in any way take the place of the teacher, but they have proven a very valuable means of making a lasting impression of the subject studied.

This article is in answer to one which appeared in a previous issue of THE AMERICAN CINEMATOGRAPHER which set forth that "Los Angeles, the home of the movies was very tardy in adopting visual instruction in its schools." Quite the contrary. Owing to the rapid progress made in this work our schools instead of being behind, are of the foremost, and recognized as such by all noted educators of the day. That eventually and in the very near future we will lead is not to be doubted

J. EVERETT HAYS.

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McClung, Hugh C—
Meehan, George—with Chas, Ray Productions, Ray Studio
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Miller, Virgil E—witb Universal Studio
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Adjustible extension finder,	45 00
Extension Arm and Upright,	30 00
Film, Matte Cutter	60 00

Subject to Change Without Notice.

Prices Cash at Our Factory.

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